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SAMPLING AND ANALYSIS PLAN FOR PRE-DESIGN INVESTIGATION FOR ZONE 4 AND OUTER PIER 1 SEDIMENT NSB NEW LONDON CT

3/1/2012

TETRA TECH

Sampling and Analysis Plan

Pre-Design Investigation for Zone 4 and Outer Pier 1 Sediment

for

Naval Submarine Base New London

Groton, Connecticut

Naval Facilities Engineering Command Mid-Atlantic

Contract Number N62470-08-D-1001

Contract Task Order WE34

March 2012

Title and Approval Page

(UFP-QAPP Manual Section 2.1)

FINAL
TIER II SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)
MARCH 2012

PRE-DESIGN INVESTIGATION FOR ZONE 4 AND OUTER PIER 1 SEDIMENT NAVAL SUBMARINE BASE – NEW LONDON GROTON, CONNECTICUT

Prepared for:
Department of the Navy
Mid-Atlantic
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Norfolk, Virginia 23511-3095

Prepared by:
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Prepared under:
Comprehensive Long-Term Environmental Action Navy
Contract No. N62470-08-D-1001
Contract Task Order WE34

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Kymberlee Keckler/USEPA RPM/Date

Mark R Lewis 29 March 2012
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Title and Approval Page

(UFP-QAPP Manual Section 2.1)

INTERNAL DRAFT
TIER II SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)
JULY 2011

PRE-DESIGN INVESTIGATION FOR ZONE 4 SEDIMENT
NAVAL SUBMARINE BASE – NEW LONDON
GROTON, CONNECTICUT

Prepared for:
Department of the Navy
Mid-Atlantic
9742 Maryland Avenue
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EXECUTIVE SUMMARY

This Uniform Federal Policy (UFP)-Sampling and Analysis Plan (SAP) describes the investigation designed to collect additional sediment samples from the Thames River adjacent to Zone 4 and at Outer Pier 1 at Naval Submarine Base – New London (NSB-NLON) located in Groton, Connecticut. The UFP-SAP was prepared by Tetra Tech, Inc. (Tetra Tech) on behalf of Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic under Contract Number N62470-08-D-1001, Contract Task Order (CTO) WE34. The field investigation described herein will be conducted to collect additional sediment data that will be used to delineate the extent of contaminated sediment. The data will also be used to support the design of a remedy for contaminated sediment that will cost-effectively reduce risks to acceptable levels.

Zone 4 and Outer Pier 1 sediment sampling was conducted during previous investigations; however, sufficient data have not been collected to fully characterize the lateral and vertical extent of contaminated sediment. In addition, insufficient geotechnical data is available for the sediment to adequately design the dewatering system required as a component of the remedy.

The environmental and engineering questions being addressed by this UFP-SAP are the following:

- To what extent (laterally and vertically) do sediment concentrations exceed ecological preliminary remediation goals (PRGs) developed as part of the Lower Subase (LS) Feasibility Study (FS)?

- Will gravity dewatering or dewatering through geotextile fabric be adequate for the sediments to be dredged during the remedy? The Navy's Remedial Design Contractor will be responsible for determining the adequacy of the test results.

To answer these questions, additional sediment sampling, as described in this SAP, will be conducted. The samples will be analyzed for select polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), pesticides, and metals and the results will be compared to PRGs along with existing data to establish the extent of sediment contamination. Select samples will also be analyzed for geotechnical engineering parameters (i.e., grain size, bulk density, Atterberg limits, specific gravity, and organic content) and appropriate dewatering tests will be performed.

SAP Sections **Page No.**

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ACRONYMS AND ABBREVIATIONS

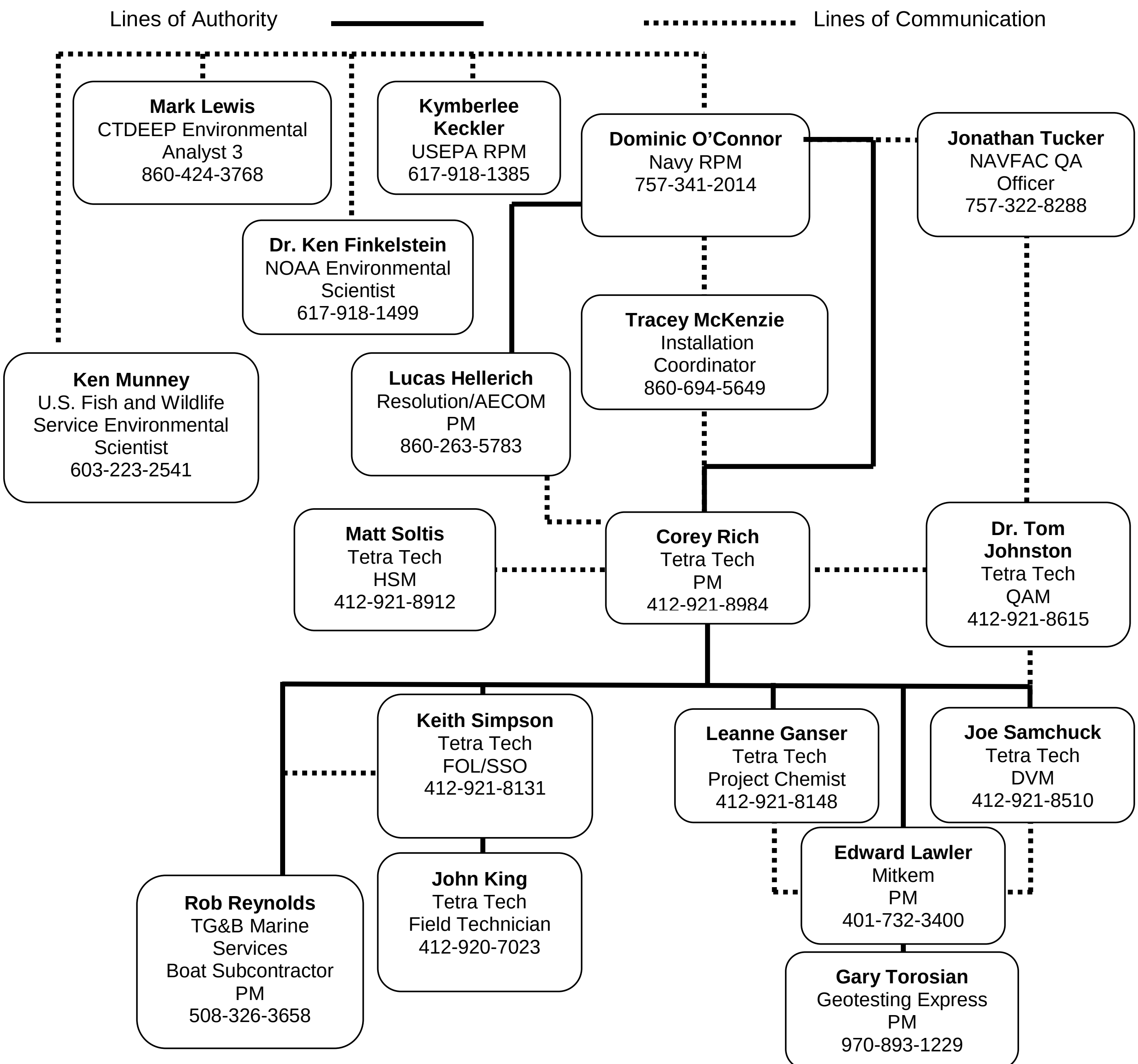
°C	Degree Celsius
%R	Percent Recovery
B&RE	Brown and Root Environmental
BERA	Baseline Ecological Risk Assessment
bgs	Below Ground Surface
bss	Below Sediment Surface
CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	Chemical of Potential Concern
CTDEEP	Connecticut Department of Energy and Environmental Protection
CTO	Contract Task Order
CSM	Conceptual Site Model
DDT	Dichlorodiphenyltrichloroethane
DL	Detection Limit
DoD	Department of Defense
DQI	Data Quality Indicator
DQO	Data Quality Objective
DVM	Data Validation Manager
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
ER-M	Effect Range-Median
ERM-Q	Effects Range Median-Quotient
FFA	Federal Facility Agreement
FOL	Field Operations Leader
FS	Feasibility Study
FTMR	Field Task Modification Request
g	Gram
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/MS	Gas Chromatography/Mass Spectrometry
GPS	Global Positioning System
GRI	Geosynthetic Research Institute
HASP	Health and Safety Plan
HMW	High Molecular Weight
HNUS	Halliburton NUS

HSM	Health and Safety Manager
ICP	Inductively Coupled Plasma
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ILCR	Incremental lifetime cancer risk
L	Liter
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantitation
LMW	Low Molecular Weight
LS	Lower Subase
mg/kg	Milligram per kilogram
mL	Milliliter
MPC	Measurement Performance Criterion
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Not Applicable
NAD83	North American Datum 1983
NAVD88	North American Vertical Datum 1988
NAVFAC	Naval Facilities Engineering Command
Navy	U. S. Department of the Navy
NCP	National Contingency Plan
NEDD	NIRIS Electronic Data Deliverable
NESO	Navy Environmental Support Office
NIRIS	Naval Installation Restoration Information Solution
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSB-NLOL	Naval Submarine Base – New London
oz	Ounce
PAH	Polycyclic Aromatic Hydrocarbon
PAL	Project Action Limit
PCB	Polychlorinated Biphenyl
PDI	Pre-design Investigation
PM	Project Manager
POC	Point of Contact
PRG	Preliminary Remediation Goal

QA	Quality Assurance
QAM	Quality Assurance Manager
QC	Quality Control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RPD	Relative Percent Difference
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SLERA	Screening-Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SSO	Site Safety Officer
SQL	Structured Query Language
TBD	To Be Determined
Tetra Tech	Tetra Tech, Inc.
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act
UFP-SAP	Uniform Federal Policy for Sampling Analysis Plan
μg/kg	Microgram per kilogram
U.S.	United States
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UST	Underground Storage Tank

1.0 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1 – Worksheet #5)



CTDEEP - Connecticut Department of Energy and Environmental Protection
DVM - Data Validation Manager
FOL - Field Operation Leader
HSM - Health and Safety Manager
NAVFAC - Naval Facilities Engineering Command
NOAA - National Oceanic and Atmospheric Administration
PM - Project Manager
QA - Quality Assurance
QAM - Quality Assurance Manager
RPM - Remedial Project Manager
SSO - Site Safety Officer
TBD - To Be Determined
USEPA - United States Environmental Protection Agency

2.0 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2 – Worksheet #6) The communication pathways for the Sampling and Analysis Plan (SAP) are shown below.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	U.S. Department of the Navy (Navy) RPM USEPA RPM CTDEEP PM NOAA PM USFWS PM	Dominic O'Connor Kymberlee Keckler Mark Lewis Ken Finkelstein Ken Munney	757-341-2014 617-918-1385 860-424-3768 617-918-1499 603-223-2541	The Navy RPM will contact the regulatory agency via phone and/or e-mail within 24 hours of recognizing the issue whenever issues arise. The Navy RPM will contact the regulatory agency via phone and/or e-mail at least 48 hours before commencement of field activities and at least 24 hours before a change in schedule so that oversight can be scheduled.
Field Progress Reports	Tetra Tech, Inc. (Tetra Tech) FOL Tetra Tech Project Manager (PM)	Keith Simpson Corey Rich	412-921-8131 412-921-8984	The Tetra Tech FOL will contact the Tetra Tech PM on a daily basis via phone, and every 1-2 days summarizing progress via e-mail.
Stop Work due to Safety Issues	Tetra Tech FOL/ SSO Tetra Tech PM Tetra Tech HSM Navy RPM TG&B Marine Services PM	Keith Simpson Corey Rich Matt Soltis Dominic O'Connor Rob Reynolds	412-921-8131 412-921-8984 412-921-8612 757-341-2014 508-326-3658	If Tetra Tech is the responsible party for a stop work command, the Tetra Tech FOL will inform onsite personnel, subcontractor(s), and the identified Project Team members within 1 hour (verbally or by e-mail). If a subcontractor is the responsible party, the subcontractor PM must inform the Tetra Tech FOL verbally within 15 minutes, and the Tetra Tech FOL will then follow the procedure listed above.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Sampling and Analysis Plan (SAP) Changes prior to Field/ Laboratory work	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM	Keith Simpson Corey Rich Dominic O'Connor	412-921-8131 412-921-8984 757-341-2014	The Tetra Tech PM will document the proposed changes via a Field Task Modification Request (FTMR) form within 5 days and send the Navy RPM a concurrence letter within 7 days of identifying the need for change if necessary. SAP amendments will be submitted by the Tetra Tech PM to the Navy RPM for review and approval. The Tetra Tech PM will send scope changes to the Project Team via e-mail within 1 business day.
Field Mobilization	NSB-NLON Point of Contact (POC)	Tracey McKenzie	860-694-5649	See requirements described in Section 8 for mobilization/demobilization and vibracore sediment sampling.
SAP Changes in the Field	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM USEPA RPM CTDEEP PM NOAA PM USFWS Resolution/AECOM PM	Keith Simpson Corey Rich Dominic O'Connor Kymberlee Keckler Mark Lewis Ken Finkelstein Ken Munney Lucas Hellerich	412-921-8131 412-921-8984 757-341-2014 617-918-1385 860-424-3768 617-918-1499 603-223-2541 860-263-5783	The Tetra Tech FOL will verbally inform the Tetra Tech PM on the day that the issue is discovered. The Tetra Tech PM will inform the Navy RPM (verbally or via e-mail) within 1 business day of discovery. The Navy RPM will issue a scope change (verbally or via e-mail), if warranted. The scope change is to be implemented before further work is executed. The Navy RPM will inform the regulatory agency (verbally or via e-mail) before implementing the change. The Tetra Tech PM will document the change via an FTMR form within 2 days of identifying the need for change and will obtain required approvals within 5 days of initiating the form.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Field Corrective Actions	Tetra Tech PM Tetra Tech QAM Navy RPM	Corey Rich Tom Johnston Dominic O'Connor	412-921-8984 412-921-8615 757-341-2014	The Tetra Tech QAM will notify the Tetra Tech PM verbally or by e-mail within 1 business day that the corrective action has been completed. The Tetra Tech PM will then notify the Navy RPM (verbally or by e-mail) within 1 business day
Analytical Corrective Actions	Mitkem Laboratories PM Geotesting Express PM Tetra Tech Project Chemist Tetra Tech DVM Tetra Tech PM Navy RPM	Edward Lawler Gary Torosian Leanne Ganser Joseph Samchuck Corey Rich Dominic O'Connor	401-732-3400 978-893-1229 412-921-8148 412-921-8510 412-921-8984 757-341-2014	The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist within 1 business day of when an issue related to laboratory data is discovered. The Tetra Tech Project Chemist will notify (verbally or via e-mail) the DVM and the Tetra Tech PM within 1 business day. Tetra Tech DVM or Project Chemist notifies Tetra Tech PM verbally or via e-mail within 48 hrs of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. The Tetra Tech PM verbally advises the – Navy RPM within 24 hours of notification from the Tetra Tech Project Chemist or DVM. The Navy RPM takes corrective action appropriate for the identified deficiency. Examples of significant laboratory deficiencies include data reported that has a corresponding failed mass spectrometer tune or initial calibration verification. Corrective actions may include a consult with the Navy Chemist.

3.0 -- Project Planning Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1 – Worksheet #9)

Project Name: Pre-Design Investigation (PDI) for Lower Subase (LS) Zone 4 Sediment **Projected Date(s) of Sampling**: Spring 2012 **Project Manager**: Corey Rich	**Site Name**: Thames River at Naval Submarine Base – New London (NSB-NLON) **Site Location**: Groton, Connecticut

Date of Session: 06-01-2011
Scoping Session Purpose: Data Quality Objective (DQO) Scoping Meeting

Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
Corey Rich	Project Manager	Tetra Tech	412-921-8984	corey.rich@tetratech.com	Project Management
Tom Johnston	Quality Assurance Manager	Tetra Tech	412-921-8615	tom.johnston@tetratech.com	DQO Facilitator
Aaron Bernhardt	Ecological Risk Assessor	Tetra Tech	412-921-8433	aaron.bernhardt@tetratech.com	Ecological Risk Assessor
Leanne Ganser	Environmental Scientist	Tetra Tech	412-921-8148	leanne.ganser@tetratech.com	Project Chemist

Comments/Decisions: The scoping session on June 1, 2011 outlined that the focus of the field investigation is to delineate sediment contamination in Zone 4 to support design of a remedy to reduce risks to acceptable levels. The former Navy RPM (James Gravette) was invited and declined to attend the DQO meeting. Regulators were previously invited to attend similar scoping sessions and indicated they did not want to participate.

Action Items: Tetra Tech was assigned the task of preparing a PDI SAP for Zone 4 sediment. The number of new sampling locations is limited to approximately 14. The Navy provided input on the sampling locations as part of the scope of work given to Tetra Tech. Tom Johnston will prepare the draft conceptual site model (CSM) and DQO summary for the SAP and these will be expanded and included throughout the SAP as appropriate. Aaron Bernhardt and Leanne Ganser will identify specific sampling locations and prepare the SAP.

Consensus Decisions: Not applicable.

Project Name: Pre-Design Investigation (PDI) for Lower Subase (LS) Zone 4 Sediment **Project Manager**: Corey Rich	**Site Name**: Thames River at Naval Submarine Base – New London (NSB-NLON) **Site Location**: Groton, Connecticut

Date of Session: 10-20-2011

Scoping Session Purpose: Discuss Zone 4 Sediment PDI SAP responses to comments

Name	Title	Affiliation	Phone #	E-Mail Address	Project Role
Corey Rich	Project Manager	Tetra Tech	412-921-8984	corey.rich@tetratech.com	Project Management
Aaron Bernhardt	Ecological Risk Assessor	Tetra Tech	412-921-8433	aaron.bernhardt@tetratech.com	Ecological Risk Assessor
Nina Balsamo	Civil Engineer	Tetra Tech	412-921-8132	Nina.balsamo@tetratech.com	Project Engineer
Dominic O'Connor	RPM	Navy	757-341-2014	dominic.oconnor1@navy.mil	Management
Tracey McKenzie	Installation Coordinator	Navy	860-694-5649	tracey.p.mckenzie@navy.mil	Management
Kymberlee Keckler	RPM	USEPA	617-918-1385	Keckler.Kymberlee@epa.gov	Regulatory Review
Mark Lewis	Environmental Analyst 3	CTDEEP	860-424-3768	Mark.lewis@ct.gov	Regulatory Review
Ken Munney	Contaminants Biologist	USFWS	603-223-2541 ext.19	kenneth_munney@fws.gov	Regulatory Review
Ken Finkelstein	Environmental Scientist	NOAA	671-918-1499	Ken.Finkelstein@noaa.gov	Regulatory Review

Comments/Decisions: Responses to EPA, NOAA, and U.S. Fish and Wildlife Service (USFWS) comments on the Draft Zone 4 Sediment PDI SAP were discussed.

Consensus Decisions: The conceptual site model will be revised to include sediment from Outer Pier 1. The SAP will be modified to include discussion of sediment from Outer Pier 1 and to identify samples for collection from Outer Pier 1. Also, additional sampling locations adjacent Zone 4 will be added.

In addition to the June 1, 2011 and October 20, 2011 scoping sessions, the Navy RPM and the Navy's Remedial Design Contractor Resolution/AECOM requested in an email on February 23, 2012 that additional geotechnical analyses and dewatering testing be conducted to support the design. Additional details regarding the required sampling test methods were sent to Tetra Tech in emails on March 5, 2012, March 3, 2012, and March 14, 2012. Resolution's project manager is Lucas Hellerich.

4.0 -- Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2 – Worksheet #10)

Descriptions below constitute a physical description of the sediment area being targeted for this investigation. These descriptions convey the current understanding of the nature and extent of sediment contamination and the basis for additional investigation.

4.1 LOCATION OF LS ZONE 4 AND OUTER PIER 1 SEDIMENT

NSB-NLON is located in southeastern Connecticut in the towns of Ledyard and Groton (Figure 4-1) and is situated on the eastern bank of the Thames River, approximately 6 miles north of Long Island Sound (not shown on figure). It is bordered to the east by Connecticut Route 12, to the south by Crystal Lake Road, and to the west by the Thames River. To the north are Long Cove and Long Cove Road.

For the purpose of this SAP, what is called the LS of NSB-NLON comprises approximately 33 acres of industrialized land along the Thames River that extends from just south of former Pier 1 to just north of Pier 33 (Figure 4-2). The LS of NSB-NLON is bordered on the west by the Thames River and on the east by the Providence and Worcester Railroad. A quay (retaining) wall (labeled as “Seawall” on Figure 4-1) runs along the Thames River for the entire length of the LS.

The LS has been subdivided into seven distinct zones (Figure 4-3). Figure 4-2 shows the extent of the Zone 4 and Outer Pier 1 boundaries. This SAP focuses only on a portion of Zone 4 sediment as well as Outer Pier 1 sediment. Zone 4 sediment extends from the southern end of Bullhead Road (Pier 6) to the southern end of former Pier 1 along the Thames River (Figure 4-4). Thames River sediments from the western edge of Zone 4 to about 400 feet offshore and about 100 feet south of Pier 2 comprises a majority of Zone 4 sediment. Outer Pier 1 is approximately 330 feet long and 150 feet wide, with the eastern boundary being the Thames River shoreline and the western boundary being the former Pier 1. Zone 4 sediment and Outer Pier 1 sediment, excluding an area dredged during a previous removal action, are the subject of this SAP.

The following environmental investigations have been conducted at Zone 4, Outer Pier 1, and other sites:

- Oil Contamination of Groundwater at Subase New London [Navy Environmental Support Office (NESO), 1979].

- Final Initial Assessment Study (Envirodyne, 1983).

- Final Site Investigation - Subsurface Oil Contamination (Wehran, 1987).
- Phase I Remedial Investigation (RI) (Atlantic, 1992).
- Removal Site Evaluation for Quay Wall (HNUS, 1995).
- Leak Testing Investigation for Fuel Oil Distribution System (Heitkamp, 1996).
- Existing Data Summary Report for LS RI [Brown and Root Environmental (B&RE), 1997a].
- Phase II RI (B&RE, 1997b).
- Site Investigation Report for Tank Farm Investigation (B&RE, 1997c).
- Annual National Pollutant Discharge Elimination System (NPDES) Storm Water Monitoring Program (Navy, 1997).
- LS RI (Tetra Tech, 1999).
- Thames River Validation Study, including baseline ecological risk assessment (BERA) (Battelle, 2008)
- Feasibility Study, including an updated human health risk assessment (Tetra Tech, 2010).
- Feasibility Study Addendum including an updated human health risk assessment (Tetra Tech, 2012).

Information obtained through these investigations, including key Zone 4 and Outer Pier 1 physical features and current Zone 4 and Outer Pier 1 sediment conditions are described below.

4.2 SITE PHYSICAL DESCRIPTION

The LS contains piers and berths for submarine docking; facilities for submarine maintenance, repair, and overhaul; and administrative buildings. The ground surface in Zone 4 slopes gently to the west toward the Thames River and is almost entirely paved or covered with buildings. The Providence and Worcester Railroad runs along the eastern border of the zone, and the Thames River borders it to the west.

Figure 4-4 identifies Zone 4 (an onshore area) and its boundaries, previous fuel oil distribution lines, steam/condensate/electrical ducts, and other utilities. Zone 4 includes Site 13 – Building 79 Former Waste Oil Pit, Site 19 – Former Solvent Storage Area (Building 316), and the Quay Wall Study Area. Fuel oil distribution lines formerly ran throughout Zone 4 before being, abandoned in place in 1996.

Surface water runoff in Zone 4 is collected in catch basins and drains through storm sewers to the Thames River. These catch basins and storm sewers are shown on Figure 4-4. Four stormwater system outfalls discharge directly to the Thames River from Zone 4. In accordance with the requirements of the basewide NPDES Stormwater General Permit for Industrial Activities, the stormwater outfall off the southwestern corner of Building 85 in the Quay Wall Study Area is monitored annually.

The remaining northern portion of Pier 1 is constructed on a solid concrete foundation which extends approximately 125 feet from the CIF building (Building 564) into Thames River and forms the western boundary of the Inner Pier 1 area (see Figure 4-4). The former pile-supported portion of Pier 1 was demolished and removed by the Navy in 2009.

4.3 SITE HISTORY

In 1867, the State of Connecticut donated a 112-acre parcel of land on the eastern bank of the Thames River to the Navy. In 1868, the Navy officially designated the property a Navy Yard that was used to moor small craft and obsolete warships and that served as a coaling station for the Atlantic fleet. NSB-NLON was gradually expanded over the ensuing decades with a major expansion during World War II. In 1946, the waterfront north of Pier 15 was developed extensively to accommodate berthing of the United States (U.S.) reserve Naval fleet. The area was dredged and filled with offsite fill material (e.g., sand and other inert material), and bulkheads, piers, support buildings, and utilities were constructed.

Currently, NSB-NLON consists of more than 207 buildings on 687 acres of land and provides base command for Naval submarine activities in the Atlantic Ocean. NSB-NLON also provides housing for Navy personnel and their families and supports submarine training facilities, military offices, medical facilities, and facilities for submarine maintenance, repair, and overhaul.

Because of the identification of historical uncontrolled hazardous waste sites within the base, NSB-NLON was placed on the National Priorities List (NPL) on August 30, 1990, by USEPA pursuant to Comprehensive Environmental Response, Compensation and Liability Act/Superfund Amendments and Reauthorization Act (CERCLA/SARA). In January 1995, the Navy, USEPA, and State of Connecticut signed the Federal Facility Agreement (FFA) for NSB-NLON, which ensures that environmental impacts associated with past and present activities at NSB-NLON are thoroughly investigated and that appropriate remedial action is pursued to protect human health and the environment. The FFA also establishes a procedural framework and timetable for developing, implementing, and monitoring appropriate responses at NSB-NLON in accordance with CERCLA/SARA, the National Contingency Plan (NCP), the Resource Conservation and Recovery Act (RCRA), Executive Order 12580, and applicable state laws.

4.4 LAND USE

Along the Thames River, tributary streams and wetlands are prevalent. NSB-NLON is one of several industrial areas on the banks of the Thames River (Tetra Tech, 2007) in the areas of Ledyard and Groton. Figure 4-5 identifies other discharge sources along the Thames River.

Zone 4 does not contain any wetlands. Land use at NSB-NLON, including LS Zone 4, is currently military/industrial. Adjacent to the northern boundary of NSB-NLON, the land is relatively undeveloped, with scattered residences. Further north, the land is residential, commercial, recreational, and open space. To the immediate south of NSB-NLON along the Thames River, the land is primarily residential with open spaces. The offshore area adjacent to the onshore portion of Zone 4 is a berthing, loading, and unloading area for ships and submarines.

4.5 SITE OPERATIONS

Various historic site operations may have impacted the LS zones. Battery overhaul was one of the largest operations at the LS prior to the advent of nuclear-powered submarines. Lead-acid battery maintenance and overhaul activities were conducted until the mid-1950s. A classified materials incinerator was also operated in the LS until 1967. It is possible that the resulting ash was disposed (specific locations unknown) in portions of the LS. Petroleum products were used by the Navy throughout the LS. Releases of petroleum products to the environment may have occurred because of leaks from underground storage tanks (USTs) and fuel distribution lines, vehicle and locomotive maintenance operations and associated waste disposal practices, and marine fueling activities. Other ship and submarine maintenance activities (e.g., sandblasting and painting) were also conducted in the LS and adjacent Thames River.

For Zone 4, operations at Site 13 (Building 79 Former Waste Oil Pit) (NESO, 1979 and Wehran, 1987) contributed significantly to the contamination found in the zone. The Building 79 service area included a pit in the northwestern corner of the building into which waste oil and solvents were reportedly drained during the cleaning and servicing of diesel engines. The pit is no longer in use and has been filled with concrete. Additional Site 13 onshore operational details can be found in the FS report (Tetra Tech, 2010).

Site 19 (Former Solvent Storage Area) includes former Building 316, which was located south of the gate valve building (Building 332). Various solvents used for equipment cleaning were stored in Building 316 until approximately 10 years ago. No significant contamination has been discovered in the vicinity of Site 19. The roof and doors of Building 316 were previously demolished leaving only the side walls.

Petroleum product releases were previously observed in the Quay Wall area of Zone 4. In addition, approximately 2,300 gallons of oily wastewater were removed. Installation and operation of five recovery wells eliminated significant migration of petroleum product from this source (Tetra Tech, 2010).

Maintenance dredging has been undertaken by the Navy in the Thames River adjacent to the LS to maintain water depths required for the submarine fleet. The most recent dredging was completed in February 2010 beyond the western edge of what is currently considered to be Zone 4 sediment (Figure 4-6). Adjacent to the eastern edge of this dredge area is a dredge area buffer zone where some sediment may have been disturbed as a result of dredging. The design for maintenance dredging indicated that the resulting sediment surface was to have a 3H:1V slope from east to west. In an attempt to achieve the correct slope, it appears that some dredging occurred in the southern half of the dredge buffer, but based on a comparison of pre-dredge and post-dredge bathymetry data the design slope was not achieved. The depth to sediment in the northern half of the dredge buffer was greater than the required operational depth of 36 feet prior to maintenance dredging; therefore, no dredging was required in that area.

The former Marine Railway at Pier 1 operated from approximately 1930 to 1960 and was used to pull ships out of the water for sandblasting/paint scraping and maintenance. These operations contributed to contamination found in Inner and Outer Pier 1. Sediment sampling identified high levels of PAHs and PCBs in sediment from Inner and Outer Pier 1. As part of a non-time critical removal action, the majority of the contaminated sediment in Inner and Outer Pier 1 was removed through dredging. Mechanical dredging was completed at Inner and Outer Pier 1 in March 2010 and hydraulic dredging will be completed at Inner Pier 1 in Spring of 2012.

4.6 HYDROGEOLOGY AND SEDIMENT PHYSICAL CHARACTERISTICS

Surface water runoff in Zone 4 is collected in catch basins and drains through storm sewers to the Thames River. These catch basins and storm sewers are shown on Figure 4-4. Four stormwater system outfalls discharge directly to the Thames River from Zone 4. In accordance with the requirements of the basewide NPDES Stormwater General Permit for Industrial Activities, the stormwater outfall off the southwestern corner of Building 85 in the Quay Wall Study Area is monitored annually.

Underlying Zone 4 is 5 to 15 feet of sand and gravel fill material, with some debris (brick fragments and fly ash) in the eastern part of the site, underlain by a natural micaceous silt and sand unit interpreted as a stratified drift deposit. The depth to the bottom of the sand and silt unit and the top of bedrock are unknown; however, the USGS bedrock map (USGS, 1967) identifies the Mamacoke Formation underlying Zone 4, and the Phase II RI report (B&RE, 1997b) estimates the bedrock to be approximately 70 feet below ground surface (bgs). In the western part of Zone 4, a wooden pier and quay wall constructed in 1940 underlie Albacore Road.

Outer Pier 1 consists of natural bedrock shoreline on the east side and open water of the Thames River on the west side (see Figure 4-4). Sediment in Outer Pier 1 consists of soft, organic-rich silt with some sand, clay, and shell material. Sediment thickness, as well as water depth, increases with distance from the shoreline and Inner Pier 1.

The unconfined water table in Zone 4 lies within the sand and gravel backfill at depths ranging from approximately 4 to 6 feet bgs, and groundwater flow is generally to the west-northwest toward the Thames River at low tide. Monitoring wells along Albacore Road are influenced by diurnal tides. The influence of the tides extends approximately 50 to 60 feet east from the Thames River.

Based on a slug test conducted during the Phase I RI (Atlantic, 1992), the hydraulic conductivity of the sand and gravel backfill is 576 feet per day. Based on water level data collected during low tide on October 27, 1998, the hydraulic gradient across Zone 4 was 0.0039.

The tidally-influenced Thames River has a net flow from north to south. The tides of the Thames River influence the discharge of groundwater from NSB-NLON on a daily basis. The following conclusions were reached in the LS RI regarding tidal influences on groundwater discharge from NSB-NLON: (1) during low tide, the hydraulic gradient is toward the Thames River and results in the greatest discharge rate of groundwater to the river; (2) during high tide, the hydraulic gradient along the Thames River is reversed and flow occurs from the river to the LS, temporarily halting the discharge of groundwater from the base to the river. A study in February 1993 showed that tidal changes of approximately 2.22 feet occurred in the Thames River, creating reversals in groundwater flow directions within the LS every tidal cycle. Water levels in the evaluated monitoring well fluctuated by 1.19 feet during the same time frame.

The grain size analysis performed on Zone 4 sediment samples collected in 2008 showed that the sediment typically contained significant amounts of silt/clay (60 to 80 percent) and lesser amounts of sand (20 to 30 percent) and gravel (less than 10 percent). The percent moisture of the samples ranged from 33.6 to 193 percent. The dry bulk density of the sediment samples ranged from 25 to 80.6 pounds per cubic foot, and the wet bulk density ranged from 73.1 to 108 pounds per cubic foot. The pH of sediment samples ranged from 8.1 to 8.5, and the salinity of the samples ranged from 0.5 to 0.8 parts per thousand. Total organic carbon (TOC) concentrations in the sediment samples ranged from 1.1 to 4.1 percent. These data can be found in Table 1-98 of the FS report (Tetra Tech, 2010).

The grain size analysis performed on Outer Pier 1 sediment samples showed that they contained varying amounts of silt/clay, sand, and gravel. A majority of the samples contained significant amounts of silt/clay (60 to 80 percent) and sand (20 to 30 percent), but only a few samples contained notable amounts of gravel (10 to 20 percent). The percent moisture of the samples ranged from 52.9 to 179 percent. The dry bulk density of the sediment samples ranged from 28.2 to 74.1 pounds per cubic foot, and the wet bulk density ranged from 76.5 to 113 pounds per cubic foot. The pH of sediment samples ranged from 7.7 and 9 S.U., and the salinity of the samples ranged from 0.5 to 0.9 part per thousand. TOC in sediment samples ranged from 2.3 to 4.5 percent. These data can be found in Table 1-100 of the FS report (Tetra Tech, 2010).

4.7 RISK ASSESSMENTS AND KNOWN EXTENT OF ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION

Human health and ecological risk assessments were conducted during the RI/FS for representative receptors that have the potential to be exposed to site-related contamination. The results were as follows:

Human Health Risk Assessment - LS RI

The HHRA for the Thames River focused on adult recreational users. Sediment was not considered a medium of concern for human exposure because the overlying water at Zone 4 is approximately 15 feet deep at the Quay Wall and falls off to nearly 40 feet approximately 50 feet from the Quay Wall and the water depths in Outer Pier 1 are greater than 10 feet deep.

Ecological Risk Assessments - LS

Data collected during the LS RI and additional data collected during a subsequent Pier 1 Marine Railway Investigation and Rapid Sediment Characterization Pilot Study were evaluated in screening-level ecological risk assessments (SLERAs). The assessments indicated that sediments in Zone 4 and Outer Pier 1 contained elevated levels of metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) that posed potential risks to benthic organisms. Several metals (chromium, lead, and zinc) were also identified to be present at concentrations posing potential risks to piscivorous birds.

A 2007 Thames River Validation Study, which included a BERA, was conducted to verify the results of the SLERA and to develop ecological cleanup goals. The validation study verified that unacceptable risks were possible for ecological receptors exposed to chemicals in the sediment. During this study, additional surface sediment samples were collected and analyzed for 10 metals, PAHs, PCB congeners, and pesticides that were previously identified as sediment chemicals of potential concern (COPCs), as well as grain size, TOC, and Acid Volatile Sulfide/Simultaneously Extracted Metals. Sample locations are shown on Figures 4-4, 4-6, and 4-7.

The BERA evaluated risks to ecological receptors including benthic invertebrates and upper-trophic-level piscivorous birds (represented by the double-crested cormorant). In 2007, dose modeling followed by bioassay testing indicated that Zone 4 survival, growth, and reproduction rates were less than reference area rates and zinc was identified as the chemical potentially responsible for these decreased rates. Bioassay results for these three rates were compared to chemistry concentrations for individual metals and pesticides, total high-molecular-weight (HMW) PAHs and total low-molecular-weight (LMW) PAHs, total PCB congeners, and three COPC indices [Total Effects Range Median-Quotient (ERM-Q), Organic ERM-Q, and Metals ERM-Q]

The ERM-Q calculations were limited to those chemical constituents identified as COPCs in the ecological screening assessment. Each chemical's concentration is normalized to its ERM and the normalized values are then averaged. The contribution to the ERM-Q from each chemical can be compared directly, and the ERM-Q reflects the total risk. The ERM is a published concentration of the median toxicity level for a given chemical (Long et al., 1995). ERMs have been developed based on an assimilation of data from a vast literature search. The median value for a chemical represents the threshold such that a concentration greater than the value is likely to be toxic to a wide range of organisms. The following equation is the formula used to calculate ERM-Qs:

$$\mathrm{ERM\text{-}Q} = \frac{1}{n}\sum_{i=1}^{n}\frac{[\mathrm{COPC}_i]}{\mathrm{ERM}_i}$$

where:

[COPC] = the concentration of an individual COPC

ERM = the published median concentration above which a toxic effect is likely

n = the total number of COPCs

i = indexes the COPCs

Tables 4-1 and 4-2 for Zone 4 and Outer Pier 1, respectively, list each COPC used in the numerator and its associated ERM used in the denominator. In addition to the standard ERM-Q, which serves as an index of potential toxicity across multiple chemicals, the regression analyses also considered an ERM-Q based only on inorganic constituents (metals ERM-Q) and an ERM-Q based only on organic constituents (organic ERM-Q). This was done to recognize that different toxicological modes of actions may result in different expressions of toxicological effects [e.g., metals may result in acute toxicity (mortality), and PCBs and PAHs may result in chronic effects]. The Metals ERM-Q was calculated using only the eight metals listed in Tables 4-1 and 4-2, and the Organic ERM-Q was calculated using the PAH, PCB congener, and pesticide constituents listed in Tables 4-1 and 4-2.

Subsequently, the New London Partnering Team reached a consensus that the Total ERM-Q of 1.17 was the dominant sediment preliminary remediation goal (PRG) and that the PCB congener PRG should be adjusted from 208 to 1,000 microgram per kilogram (µg/kg) which is the typical criterion that has been used for other sediment remediation projects in Connecticut and other parts of the U. S. and meets risk-based standards under the Toxic Substances Control Act (TSCA) (January 28, 2009 Team Meeting).

Current Sediment Contamination Conditions

The results for all sediment contaminant data collected through 2010 are presented in Table 4-3 for Zone 4 and Table 4-4 for Outer Pier 1. Figures 4-6 and 4-7 present the Total ERM-Qs and Total PCB concentrations for each Zone 4 and Outer Pier 1 sediment sample, respectively for each depth (see Tables 4-1 and 4-2). The values are shaded green if the Total ERM-Q and Total PCB concentration are less than their respective PRGs (1.17 for the Total ERM-Q and 1 mg/kg for Total PCBs) and are shaded red if either the Total ERM-Q or Total PCB concentration is greater than its respective PRG. The figure also displays Total ERM-Q isopleths that depict the estimated locations of contaminated and uncontaminated sediments at three different sediment depths. Total PCB concentration isopleths are not shown because Total ERM-Q isopleths encompass a larger area.

Zone 4 Sediment Contamination Conditions

The text below describes key characteristics of the Zone 4 contamination depicted on Figure 4-6. In general, the highest levels of contamination are closest to the Quay Wall and decrease with distance from the wall. The surface sediments are generally less contaminated than sediments in the 2 to 6 feet below sediment surface (bss) range.

PAH concentrations were generally lower in surface sediment samples (0 to 1 foot) than in subsurface samples (2 to 4 feet and 4 to 6 feet). Sediment collected from TRZ4-SD-005 at 4 to 6 feet bss and TRZ4-SD-001 at 2 to 4 feet bss had the maximum concentrations of PAHs. TRZ4-SD-005 was located within a Navy proposed maintenance dredge buffer zone. Generally, maximum concentrations of LMW

PAHs were found at TRZ4-SD-005, and maximum concentrations of HMW PAHs were found at TRZ4-SD-001.

Total dichlorodiphenyltrichloroethane (DDT) was detected in all 2008 sediment samples. The maximum total DDT concentration (245 µg/kg) was detected in the sample from location TRZ4-SD-002 near the Quay Wall at 4 to 6 feet bss. In samples with total DDT detections greater than 100 µg/kg, only one sample was from the 4- to 6-foot depth interval (TRZ4-SD-002), five samples were from the 2- to 4-foot depth interval, and two were from the 0- to 1-foot depth. Most other pesticides were detected in less than half of the samples collected, with maximum concentrations generally in the subsurface samples.

Twenty-three PCB congeners were detected at varying frequencies. The maximum total PCB congener concentration (1,425 µg/kg) was detected in sample TRZ4-SD-002 at 4 to 6 feet bss. Similar elevated total PCB congener concentrations (1,317 and 1,163 µg/kg, respectively) were detected in samples from 4 to 6 feet bss at TRZ4-SD-005 and TRZ4-SD-006. Concentrations of total PCB congener concentrations generally decreased with distance from the Quay Wall Study Area and were generally greater in subsurface samples than in surface samples.

Metals were detected in all 24 samples, and concentrations were generally greatest in the 2- to 4-foot depth interval. Copper [372 milligram per kilogram (mg/kg)], lead (483 mg/kg), and zinc (2,110 mg/kg) were the metals detected at the greatest concentrations, all in sample TRZ4-SD-001 from 2 to 4 feet bss.

Outer Pier 1 Sediment Contamination Conditions

Outer Pier 1 was included in the Engineering Evaluation/Cost Analysis (EE/CA) and Non-Time-Critical Removal Action (NTCRA) which also addressed elevated concentrations of contaminants found in Inner Pier 1 (Tetra Tech, 2009). The removal action area for a portion of Outer Pier 1 was defined as an arc south of the boundary between Inner and Outer Pier 1. The first phase of the removal action which addressed Inner Pier 1 and most of Outer Pier 1 was completed in March 2010 and the second phase of the removal action for Inner Pier 1 will be completed in Spring 2012. Figures 4-4 and 4-7 show the area dredged during the removal action. Results from samples collected from the dredged area prior to dredging are not presented on the figures as the contaminated sediment was removed.

The following text describes key characteristics of the Outer Pier 1 contamination depicted on Figure 4-7. In general, the samples did not exceed ecological PRGs. The only exceedance of ecological PRGs outside of the excavation area for the Outer Pier 1 area was one sample from TRP1-SD-005 located at the southern end of former Pier 1 had a Total ERM-Q greater than 1.17 in the sample from 4 to 6 feet bss. Concentrations of HMW PAHs, LMW PAHs, and some metals exceeded their respective ERM values in the sample from 4 to 6 feet bss at TRP1-SD-005.

4.8 CONCEPTUAL SITE MODEL

Figure 4-8 depicts the CSM for Zone 4 and Outer Pier 1 sediment. The primary onshore Zone 4 contaminant source is Site 13 (Building 79 Former Waste Oil Pit). Contaminants associated with this source and other nearby industrial operations may have migrated from onshore to offshore via surface runoff (including storm sewer discharges), industrial outfalls, and groundwater. Surface runoff is expected to be the greater current contributor to offshore contamination at Zone 4 because Zone 4 is largely paved or covered by buildings that prevent infiltration of precipitation and historic releases from Site 13 in the Quay Wall area were remediated. Surface runoff is also expected to be a current contributor to offshore contamination at Outer Pier 1 because the onshore areas adjacent to Outer Pier 1 are paved. Releases into the water from painting or sandblasting ships on the former Marine Railway at Pier 1 and miscellaneous dumping of materials from ships are historic sources of contamination at Outer Pier 1.

Although potential upstream industrial discharge may occur, it is impractical to separate non-Zone 4/Outer Pier 1 contamination from Zone 4 and Outer Pier 1 related contamination because the hydrology is complicated. One of the complicating factors is tidal fluctuations. Tidal fluctuations at Zone 4 and Outer Pier 1 cause fluctuations in the Thames River water level of as much as 2 feet per tidal cycle and create a back and forth movement of surface water and sediment. The tides also create a back and forth movement of groundwater, which retards groundwater flow toward the river during certain periods of the day, although the net groundwater flow is toward the Thames River.

After several environmental investigations, contaminants associated with potentially unacceptable levels of risk to ecological receptors including benthic organisms and piscivorous birds at Zone 4 and Outer Pier 1 were identified to be select PAHs, PCBs, pesticides, and metals. Benthic organisms receive direct exposure and organisms at higher trophic levels that feed on these benthic organisms and fish can be exposed to contamination via the food chain.

Contaminants in surface water partition between the water and sediments at the bottom of the water column and particulates suspended in the water column. Suspended particulates larger than colloidal size eventually settle into the bottom sediments. The sediments serve as an accumulator of contaminants, either because of this eventual settling or because they tend to preferentially adsorb chemicals. Adsorption is an effective sequestering mechanism for moderate to high molecular PAHs, PCBs, pesticides, and heavy metals, the primary contaminants of concern for this investigation. Sediment movement within and in and out of Zone 4 and Outer Pier 1 has not been studied, so the potential for migration of contaminants adsorbed to sediments is not well understood; however, because the primary contamination in Zone 4 and Outer Pier 1 is at depth (greater than 2 feet), it is unlikely that the contaminated sediments are migrating. The degree of contaminant partitioning between surface water and sediments depends on the contact time, the degree of mixing between sediment and water, temperature, and other factors. Upon suspension or dissolution in the water column, contaminants can move in the water. Dense, large sediment particles move less readily than the less dense, smaller grained particles. Dissolved contaminants move at the same rate as the surface water. These movements of water and sediment tend to distribute the contamination laterally. Silt accumulation buries older sediments with newer sediment. Dredging removes existing sediments and may cause redistribution of sediment. Contaminated sediments that were dredged were removed so that they can no longer contribute contaminants to the dissolved phase or to subsequent migration as adsorbed species. It is possible for a small amount of sediment in the dredge volume to be redistributed to lesser contaminated areas but this effect is not expected to be significant.

The need to remediate sediments because of unacceptable risk levels was established during the RI/FS. A Record of Decision has not been signed and a final remedy has not been selected to date. The cost of remediation is linked to the extent and volume of sediment that must be remediated because every cubic yard of sediment that must be remediated adds additional cost to most remediation strategies. Therefore, delineating the extent of contamination to a finer spatial resolution than is currently known would support more accurate remediation cost estimates. PRGs by which delineation of contamination can be determined were developed (Battelle, 2008). These goals are an ERM-Q equal to 1.17 and a Total PCB concentration of 1 mg/kg. In addition, supplemental geotechnical analyses and dewatering testing will provide information that is critical to supporting the remedial design.

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
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PARAMETER	ERM	ZONE-4 Z4-33 CAB-36 20030617		ZONE-4 Z4-36 CAB-39 20030617		ZONE-4 Z4-37 CAB-41 20030617		ZONE-4 Z4-39 CAB-43 20030617	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	13.2	0.19	10.7	0.15	14.4	0.21	10.7	0.15
CADMIUM (mg/kg)	9.6	1.6	0.16	3.5	0.36	0.67	0.07	1.4	0.15
CHROMIUM (mg/kg)	370	263 B	0.71	364 B	0.98	98.2 B	0.27	125 B	0.34
COPPER (mg/kg)	270	305	1.1	628	2.3	103	0.38	98.6	0.37
LEAD (mg/kg)	218	345	1.6	1240	5.7	102	0.47	109	0.5
NICKEL (mg/kg)	51.6	90.6	1.8	188	3.6	28.9	0.56	25.9	0.5
SELENIUM (mg/kg)	1.4	1.1	0.81	2.2	1.6	0.92	0.65	0.89	0.64
ZINC (mg/kg)	410	3310 B	8.1	4070 B	9.9	194 B	0.47	182 B	0.44
TOTAL PCB CONGENERS (µg/kg)	180	300	1.7	1000	5.8	150	0.82	230	1.3
ALPHA-CHLORDANE (µg/kg)	6	0.75	0.13	6.1	1.0	0.66 J	0.11	0.96	0.16
TOTAL DDT (µg/kg)	46.1	8.7	0.19	56	1.2	10	0.22	22	0.48
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	23000	2	20000	2	40000	4	10000	1
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	3300	1	2200	0.7	3200	1	1700	0.5
Total ERM-Q			1.5		2.7		0.72		0.51

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 13

PARAMETER	ERM	ZONE-4 Z4-40 CAB-44 20030617		ZONE-4 Z4-42 CAB-46 20030618		ZONE-4 Z4-43 CAB-47 20030618		ZONE-4 Z4-44 CAB-48 20030618	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	14.1	0.2	14.9	0.21	11.2	0.16	11.3	0.16
CADMIUM (mg/kg)	9.6	0.56	0.058	0.52	0.054	0.44	0.046	0.3	0.031
CHROMIUM (mg/kg)	370	98.8 B	0.27	101 B	0.27	93.5 B	0.25	71.1 B	0.19
COPPER (mg/kg)	270	88.6	0.33	94.4	0.35	101	0.37	147	0.54
LEAD (mg/kg)	218	126	0.58	95.2	0.44	88.1	0.4	124	0.57
NICKEL (mg/kg)	51.6	28.9	0.56	30.0	0.58	27.2	0.53	38.1	0.74
SELENIUM (mg/kg)	1.4	0.93	0.67	1.0	0.73	0.81	0.58	0.66	0.47
ZINC (mg/kg)	410	171 B	0.42	170 B	0.41	191 B	0.47	958 B	2.3
TOTAL PCB CONGENERS (µg/kg)	180	110	0.62	110	0.63	100	0.58	53	0.29
ALPHA-CHLORDANE (µg/kg)	6	0.64 J	0.11	0.60 J	0.1	0.59 J	0.098	0.33 J	0.055
TOTAL DDT (µg/kg)	46.1	9.1	0.2	9.3	0.2	7.8	0.17	4.0	0.088
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	45000	5	85000	9	15000	2	7600	0.8
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	8000	3	20000	6	1900	0.6	1300	0.4
Total ERM-Q			0.86		1.5		0.45		0.51

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
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PARAMETER	ERM	ZONE-4 Z4-46 CAB-50 20030618		ZONE-4 Z4-C1 DAD-8-0204 20041011		ZONE-4 Z4-C1 DAD-8-0405 20041011		ZONE-4 Z4-C1 DAD-8-0507 20041011	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	8.1	0.12	14.2	0.2	12.5	0.18	0.094	0.0013
CADMIUM (mg/kg)	9.6	0.36	0.038	1.3	0.14	1.7	0.18	0.029	0.003
CHROMIUM (mg/kg)	370	83.7 B	0.23	112	0.3	127	0.34	14.6	0.04
COPPER (mg/kg)	270	64.1	0.24	128	0.47	129	0.48	2.8	0.011
LEAD (mg/kg)	218	69.7	0.32	149 J	0.68	162 J	0.74	1.79 J	0.0082
NICKEL (mg/kg)	51.6	19.1	0.37	36.90 J	0.72	43.18 J	0.84	3.70 J	0.072
SELENIUM (mg/kg)	1.4	0.53	0.38	0.91	0.65	0.75	0.53	0.020 U	0.0071
ZINC (mg/kg)	410	109 B	0.27	275 J	0.67	351 J	0.86	12.58 J	0.031
TOTAL PCB CONGENERS (µg/kg)	180	80	0.45	240	1.3	450	2.5	1.1	0.0062
ALPHA-CHLORDANE (µg/kg)	6	0.20 J	0.033	2.0	0.33	3.3	0.55	0.05 UJ	0.0042
TOTAL DDT (µg/kg)	46.1	3.7	0.079	11	0.23	13	0.28	0.06	0.0013
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	7000	0.7	26000	3	30000	3	5	0.0005
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	1400	0.4	4600	1	4100	1	2	0.0007
Total ERM-Q			0.28		0.76		0.92		0.014

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 4 OF 13

PARAMETER	ERM	ZONE-4 Z4-C2 DAD-9-0204 20041011		ZONE-4 Z4-C2 DAD-9-0405 20041011		ZONE-4 Z4-S1 DAD-1 20041012		ZONE-4 Z4-S2 DAD-2 20041013	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	2.6	0.036	1.2	0.017	13.2	0.19	13.9	0.2
CADMIUM (mg/kg)	9.6	0.31	0.033	0.14	0.014	0.21	0.022	0.58	0.061
CHROMIUM (mg/kg)	370	28.4	0.077	22.4	0.06	61.5	0.17	84.6	0.23
COPPER (mg/kg)	270	21.8	0.081	15.5	0.057	255	0.94	97.3 J	0.36
LEAD (mg/kg)	218	31.46 J	0.14	26.60 J	0.12	54.9	0.25	102 J	0.47
NICKEL (mg/kg)	51.6	10.71 J	0.21	6.76 J	0.13	14.3	0.28	26.4	0.51
SELENIUM (mg/kg)	1.4	0.11	0.076	0.031	0.022	0.396 J	0.28	0.8	0.57
ZINC (mg/kg)	410	67.6 J	0.16	37.64 J	0.092	3710	9.0	321	0.78
TOTAL PCB CONGENERS (µg/kg)	180	49	0.27	22	0.12	63	0.35	160	0.9
ALPHA-CHLORDANE (µg/kg)	6	0.31	0.052	0.11	0.018	0.68	0.11	0.9	0.15
TOTAL DDT (µg/kg)	46.1	0.96	0.021	0.41	0.0089	5.2	0.11	5.2	0.11
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	1400	0.1	520	0.05	29000	3	25000	3
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	180	0.06	90	0.03	4900	2	6100	2
Total ERM-Q			0.11		0.057		1.3		0.68

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 5 OF 13

PARAMETER	ERM	ZONE-4 Z4-S3 DAD-3 20041013		ZONE-4 Z4-S4 DAD-4 20041013		ZONE-4 Z4-S5 DAD-5 20041012		ZONE-4 Z4-S6 DAD-6 20041012	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	12.6	0.18	13.5	0.19	12.7	0.18	7.4	0.11
CADMIUM (mg/kg)	9.6	0.54	0.056	0.52	0.054	0.49	0.051	0.91	0.094
CHROMIUM (mg/kg)	370	85.7	0.23	88.0	0.24	88.1	0.24	53.9	0.15
COPPER (mg/kg)	270	95.2 J	0.35	85.0 J	0.31	83.6	0.31	59.9	0.22
LEAD (mg/kg)	218	93.9 J	0.43	89.4 J	0.41	84.5	0.39	119	0.55
NICKEL (mg/kg)	51.6	26.6	0.52	27.7	0.54	26.1	0.51	17.0	0.33
SELENIUM (mg/kg)	1.4	0.61	0.44	0.68	0.49	0.747 J	0.53	0.428 J	0.31
ZINC (mg/kg)	410	255	0.62	202	0.49	191	0.47	216	0.53
TOTAL PCB CONGENERS (µg/kg)	180	110	0.61	81	0.45	100	0.56	190	1.0
ALPHA-CHLORDANE (µg/kg)	6	0.84 J	0.14	0.59	0.098	0.94	0.16	0.88	0.15
TOTAL DDT (µg/kg)	46.1	3.5	0.076	4.3	0.092	6.5	0.14	8.0	0.17
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	48000	5	31000	3	20000	2	9100	0.9
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	11000	3	7800	2	2600	0.8	1300	0.4
Total ERM-Q			0.92		0.69		0.50		0.38

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
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PARAMETER	ERM	ZONE-4 Z4-S6R DAD-6-D 20041012		ZONE-4 Z4-1 GAB-001 20070426		ZONE-4 Z4-2 GAB-002 20070425		ZONE-4 Z4-3 GAB-003 20070426	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	5.6	0.08	12.5	0.18	10.5	0.15	13.9	0.2
CADMIUM (mg/kg)	9.6	0.96	0.1	0.83	0.086	2.8	0.29	1.1	0.11
CHROMIUM (mg/kg)	370	87.7	0.24	321	0.87	313	0.85	105	0.28
COPPER (mg/kg)	270	132 J	0.49	568	2.1	735	2.7	121	0.45
LEAD (mg/kg)	218	131 J	0.6	524	2.4	841	3.9	136	0.62
NICKEL (mg/kg)	51.6	24.8	0.48	165	3.2	286	5.5	32.3	0.63
SELENIUM (mg/kg)	1.4	0.5	0.36	1.3	0.91	1.9	1.3	1.1	0.76
ZINC (mg/kg)	410	468	1.1	3070	7.5	3720	9.1	234	0.57
TOTAL PCB CONGENERS (µg/kg)	180	380	2.1	230	1.3	370	2.0	180	1.0
ALPHA-CHLORDANE (µg/kg)	6	0.94	0.16	0.8	0.13	2.5	0.42	0.73	0.12
TOTAL DDT (µg/kg)	46.1	13	0.29	9.9	0.21	27	0.59	12	0.26
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	12000	1	34000	4	18000	2	18000	2
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	1700	0.5	7900	2	2600	0.8	7300	2
Total ERM-Q			0.60		1.9		2.3		0.71

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 7 OF 13

PARAMETER	ERM	ZONE-4 Z4-4 GAB-004 20070426		ZONE-4 Z4-4 GAB-004-D 20070426		ZONE-4 Z4-5 GAB-005 20070425		ZONE-4 Z4-6 GAB-006 20070425	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	13.0	0.19	13.2	0.19	13.8	0.2	11.0	0.16
CADMIUM (mg/kg)	9.6	0.91	0.095	0.93	0.096	0.65	0.067	0.5	0.052
CHROMIUM (mg/kg)	370	100	0.27	99.7	0.27	86.6	0.23	79.3	0.21
COPPER (mg/kg)	270	115	0.43	112	0.41	198	0.73	84.0	0.31
LEAD (mg/kg)	218	112	0.51	119	0.55	106	0.49	78.6	0.36
NICKEL (mg/kg)	51.6	32.0	0.62	32.5	0.63	30.0	0.58	27.6	0.53
SELENIUM (mg/kg)	1.4	0.94	0.67	0.85	0.61	0.88	0.63	0.72	0.52
ZINC (mg/kg)	410	218	0.53	209	0.51	766	1.9	163	0.4
TOTAL PCB CONGENERS (µg/kg)	180	180	1.0	110	0.58	90	0.5	83	0.46
ALPHA-CHLORDANE (µg/kg)	6	0.94	0.16	0.61	0.1	0.64	0.11	0.57	0.095
TOTAL DDT (µg/kg)	46.1	11	0.25	8.5	0.18	8.0	0.17	6.7	0.14
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	17000	2	11000	1	14000	1	9100	0.9
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	5200	2	3000	1	2300	0.7	2000	0.6
Total ERM-Q			0.63		0.48		0.59		0.37

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 8 OF 13

PARAMETER	ERM	ZONE-4 TRZ4-SD-001 TRZ4-SD-001A-0204 20081106		ZONE-4 TRZ4-SD-001 TRZ4-SD-001A-0406 20081106		ZONE-4 TRZ4-SD-001 TRZ4-SD-001B-0001 20081106		ZONE-4 TRZ4-SD-002 TRZ4-SD-002A-0204 20081106	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	15.20 J	0.22	16.40 J	0.23	13.90 J	0.2	15.7	0.22
CADMIUM (mg/kg)	9.6	2.00 J	0.21	2.20 J	0.23	0.620 J	0.065	1.4	0.15
CHROMIUM (mg/kg)	370	155 J	0.42	129 J	0.35	77.7 J	0.21	86.3	0.23
COPPER (mg/kg)	270	372 J	1.4	266 J	0.99	132 J	0.49	162 J	0.6
LEAD (mg/kg)	218	483 J	2.2	308 J	1.4	202 J	0.93	178 J	0.82
NICKEL (mg/kg)	51.6	89.2	1.7	72.7	1.4	30.1	0.58	29.70 J	0.58
SELENIUM (mg/kg)	1.4	5.7	4.1	6.6	4.7	6.0	4.3	5.5	3.9
ZINC (mg/kg)	410	2110 J	5.1	652 J	1.6	264 J	0.64	323 J	0.79
TOTAL PCB CONGENERS (µg/kg)	180	380	2.1	450	2.5	210	1.2	610	3.4
ALPHA-CHLORDANE (µg/kg)	6	3.4 UJ	0.28	3.5 U	0.29	0.92 U	0.077	35 U	2.9
TOTAL DDT (µg/kg)	46.1	10	0.22	23	0.51	12	0.26	100	2.2
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	84000	9	55000	6	11000	1	37000	4
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	14000	5	20000	6	1800	0.6	6900	2
Total ERM-Q			2.4		2.0		0.82		1.7

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 9 OF 13

PARAMETER	ERM	ZONE-4 TRZ4-SD-002 TRZ4-SD-002A-0406 20081106		ZONE-4 TRZ4-SD-002 TRZ4-SD-002B-0001 20081106		ZONE-4 TRZ4-SD-003 TRZ4-SD-003A-0204 20081106		ZONE-4 TRZ4-SD-003 TRZ4-SD-003A-0406 20081106	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	12.3	0.18	11.1	0.16	17.2	0.25	6.6	0.094
CADMIUM (mg/kg)	9.6	2.4	0.25	0.9	0.094	0.83	0.086	0.62	0.065
CHROMIUM (mg/kg)	370	128	0.35	81.7	0.22	85.1	0.23	76.9	0.21
COPPER (mg/kg)	270	171 J	0.63	183 J	0.68	132 J	0.49	174 J	0.64
LEAD (mg/kg)	218	187 J	0.86	223 J	1.0	162 J	0.74	206 J	0.94
NICKEL (mg/kg)	51.6	30.10 J	0.58	41.50 J	0.8	30.80 J	0.6	58.1 J	1.1
SELENIUM (mg/kg)	1.4	6.1	4.4	5.0	3.6	6.2	4.4	4.0	2.9
ZINC (mg/kg)	410	292 J	0.71	523 J	1.3	242 J	0.59	665 J	1.6
TOTAL PCB CONGENERS (µg/kg)	180	1400	7.9	470	2.6	470	2.6	340	1.9
ALPHA-CHLORDANE (µg/kg)	6	18 U	1.5	17 U	1.4	44 UJ	3.7	5.8 U	0.48
TOTAL DDT (µg/kg)	46.1	240	5.3	78	1.7	130	2.8	34	0.74
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	5100	0.5	20000	2	21000	2	19000	2
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	3000	0.9	3000	1	2400	0.8	4300	1
Total ERM-Q			1.9		1.3		1.5		1.1

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
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PARAMETER	ERM	ZONE-4 TRZ4-SD-003 TRZ4-SD-003B-0001 20081106		ZONE-4 TRZ4-SD-004 TRZ4-SD-004A-0204 20081107		ZONE-4 TRZ4-SD-004 TRZ4-SD-004A-0406 20081107		ZONE-4 TRZ4-SD-004 TRZ4-SD-004B-0001 20081107	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	13.4	0.19	4.70 J	0.067	10.90 J	0.16	4.10 J	0.059
CADMIUM (mg/kg)	9.6	0.61	0.064	0.470 J	0.049	1.50 J	0.16	0.190 J	0.02
CHROMIUM (mg/kg)	370	66.5	0.18	52.4 J	0.14	85.3 J	0.23	40.20 J	0.11
COPPER (mg/kg)	270	109 J	0.4	92.1 J	0.34	165 J	0.61	100 J	0.37
LEAD (mg/kg)	218	108 J	0.5	157 J	0.72	400 J	1.8	127 J	0.58
NICKEL (mg/kg)	51.6	25.20 J	0.49	28.10 J	0.54	24.70 J	0.48	40.50 J	0.78
SELENIUM (mg/kg)	1.4	5.0	3.6	2.6	1.9	4.7	3.4	2.6	1.9
ZINC (mg/kg)	410	239 J	0.58	273 J	0.67	256 J	0.62	359 J	0.88
TOTAL PCB CONGENERS (µg/kg)	180	260	1.5	110	0.59	460	2.6	61	0.34
ALPHA-CHLORDANE (µg/kg)	6	38 U	3.2	0.46 J	0.077	2.3	0.38	0.47 U	0.039
TOTAL DDT (µg/kg)	46.1	110	2.4	8.4	0.18	37	0.8	1.4	0.031
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	14000	1	8900	0.9	29000	3	3400	0.4
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	1400	0.4	1200	0.4	6900	2	640	0.2
Total ERM-Q			1.2		0.50		1.3		0.43

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 11 OF 13

PARAMETER	ERM	ZONE-4 TRZ4-SD-005 TRZ4-SD-005A-0204 20081106		ZONE-4 TRZ4-SD-005 TRZ4-SD-005A-0406 20081106		ZONE-4 TRZ4-SD-005 TRZ4-SD-005B-0001 20081106		ZONE-4 TRZ4-SD-006 TRZ4-SD-006A-0204 20081106	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	16.1	0.23	13.2	0.19	17.1	0.24	16.8	0.24
CADMIUM (mg/kg)	9.6	1.1	0.11	1.9	0.2	0.81	0.084	2.6	0.27
CHROMIUM (mg/kg)	370	115	0.31	109	0.29	81.0	0.22	134	0.36
COPPER (mg/kg)	270	348 J	1.3	212 J	0.79	144 J	0.53	202 J	0.75
LEAD (mg/kg)	218	248 J	1.1	288 J	1.3	158 J	0.72	197 J	0.9
NICKEL (mg/kg)	51.6	61.1 J	1.2	34.80 J	0.67	30.00 J	0.58	46.90 J	0.91
SELENIUM (mg/kg)	1.4	6.7	4.8	5.7	4.1	6.7	4.8	6.7	4.8
ZINC (mg/kg)	410	730 J	1.8	367 J	0.9	240 J	0.59	353 J	0.86
TOTAL PCB CONGENERS (µg/kg)	180	340	1.9	1300	7.3	350	1.9	780	4.3
ALPHA-CHLORDANE (µg/kg)	6	8 U	0.67	20 U	1.7	22 U	1.8	46 U	3.8
TOTAL DDT (µg/kg)	46.1	190	4.0	80	1.7	88	1.9	140	2.9
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	14000	1	40000	4	8800	0.9	6200	0.6
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	4200	1	41000	13	940	0.3	1300	0.4

Total ERM-Q	1.6	2.8	1.1	1.6

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 12 OF 13

PARAMETER	ERM	ZONE-4 TRZ4-SD-006 TRZ4-SD-006A-0406 20081106		ZONE-4 TRZ4-SD-006 TRZ4-SD-006B-0001 20081106		ZONE-4 TRZ4-SD-007 TRZ4-SD-007A-0204 20081106		ZONE-4 TRZ4-SD-007 TRZ4-SD-007A-0406 20081106	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	8.1	0.12	13.9	0.2	9.3	0.13	8.6	0.12
CADMIUM (mg/kg)	9.6	1.3	0.14	0.61	0.064	0.25	0.026	0.25	0.026
CHROMIUM (mg/kg)	370	72.9	0.2	69.7	0.19	38.1	0.1	36.8	0.099
COPPER (mg/kg)	270	113 J	0.42	104 J	0.39	27.10 J	0.1	14.50 J	0.054
LEAD (mg/kg)	218	147 J	0.67	101 J	0.46	21.20 J	0.097	7.60 J	0.035
NICKEL (mg/kg)	51.6	20.80 J	0.4	26.90 J	0.52	20.90 J	0.41	21.30 J	0.41
SELENIUM (mg/kg)	1.4	3.8	2.7	6.3	4.5	4.3	3.1	5.5	3.9
ZINC (mg/kg)	410	209 J	0.51	185 J	0.45	68.9 J	0.17	52.4 J	0.13
TOTAL PCB CONGENERS (µg/kg)	180	1200	6.5	230	1.3	41	0.23	46	0.26
ALPHA-CHLORDANE (µg/kg)	6	14 U	1.2	26 U	2.2	3.5 U	0.29	3.4 U	0.28
TOTAL DDT (µg/kg)	46.1	63	1.4	75	1.6	10	0.22	9.9	0.21
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	7100	0.7	12000	1	670	0.07	35	0.004
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	960	0.3	1400	0.4	91	0.03	23	0.007

Total ERM-Q			1.2		1.0		0.38		0.43

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-1

ZONE 4 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 13 OF 13

PARAMETER	ERM	ZONE-4 TRZ4-SD-007 TRZ4-SD-007B-0001 20081106		ZONE-4 TRZ4-SD-008 TRZ4-SD-008A-0204 20081106		ZONE-4 TRZ4-SD-008 TRZ4-SD-008A-0406 20081106		ZONE-4 TRZ4-SD-008 TRZ4-SD-008B-0001 20081106	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	16.4	0.23	15.3	0.22	17.0	0.24	14.3	0.2
CADMIUM (mg/kg)	9.6	0.81	0.084	0.99	0.1	1.4	0.15	0.7	0.073
CHROMIUM (mg/kg)	370	91.5	0.25	86.1	0.23	100	0.27	76.9	0.21
COPPER (mg/kg)	270	165 J	0.61	141 J	0.52	166 J	0.61	118 J	0.44
LEAD (mg/kg)	218	148 J	0.68	122 J	0.56	148 J	0.68	105 J	0.48
NICKEL (mg/kg)	51.6	35.00 J	0.68	36.50 J	0.71	39.70 J	0.77	29.00 J	0.56
SELENIUM (mg/kg)	1.4	6.5	4.6	6.6	4.7	5.7	4.1	6.3	4.5
ZINC (mg/kg)	410	224 J	0.55	211 J	0.51	260 J	0.63	206 J	0.5
TOTAL PCB CONGENERS (µg/kg)	180	250	1.4	280	1.6	330	1.8	200	1.1
ALPHA-CHLORDANE (µg/kg)	6	24 U	2.0	45 U	3.8	6 J	1.0	5 U	0.42
TOTAL DDT (µg/kg)	46.1	110	2.5	130	2.9	89	1.9	21	0.45
HIGH MOLECULAR WEIGHT PAHS (µg/kg)	9600	14000	1	7900	0.8	9700	1	5900	0.6
LOW MOLECULAR WEIGHT PAHS (µg/kg)	3160	1700	0.5	980	0.3	1900	0.6	900	0.3
Total ERM-Q			1.2		1.3		1.1		0.76

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-2

**OUTER PIER 1 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 5**

PARAMETER	ERM	OUTER PIER 1 SBP-5 SBP-5-GRAB 19991028		OUTER PIER 1 SBP-6 SBP-6-GRAB 19991028		OUTER PIER 1 P1-53 CAB-59 20030617		OUTER PIER 1 P1-55 CAB-61 20030617	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	12	0.171	13	0.186	14.4	0.206	14.6	0.209
CADMIUM (mg/kg)	9.6	0.5	0.052	0.42	0.044	0.413	0.043	0.436	0.045
CHROMIUM (mg/kg)	370	61	0.165	58	0.157	94.7 B	0.256	93.5 B	0.253
COPPER (mg/kg)	270	120	0.444	79	0.293	84	0.311	74	0.274
LEAD (mg/kg)	218	110	0.505	86	0.394	94	0.431	88	0.404
NICKEL (mg/kg)	51.6	25	0.484	22	0.426	28.6	0.554	30.4	0.589
SELENIUM (mg/kg)	1.4	NA	NA	NA	NA	0.827	0.591	0.868	0.620
ZINC (mg/kg)	410	220	0.537	160	0.390	167 B	0.407	149 B	0.363
TOTAL PCB CONGENERS (µg/kg)	180	62.2	0.346	38.4	0.213	106.83	0.594	87.22	0.485
ALPHA-CHLORDANE (µg/kg)	6	1.5 U	0.125	1.5 U	0.125	1.2	0.200	0.54 J	0.090
TOTAL DDT (µg/kg)	46.1	2.25	0.049	2.25	0.049	12.69	0.275	7.32	0.159
HIGH MOLECULAR WEIGHT PAHs (µg/kg)	9600	4069	0.424	3508	0.365	8489.01	0.884	5515.48	0.575
LOW MOLECULAR WEIGHT PAHs (µg/kg)	3160	795	0.252	666	0.211	1157.52	0.366	823.15	0.260
Total ERM-Q			0.296		0.238		0.394		0.333

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-2

**OUTER PIER 1 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 5**

PARAMETER	ERM	OUTER PIER 1 P1-C5 DAD-31-0204 20041011		OUTER PIER 1 P1-C5 DAD-31-0406 20041011		OUTER PIER 1 P4 DAD-23 20041012		OUTER PIER 1 P4R DAD-23-D 20041012	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	12.9	0.184	10.3	0.147	13.1	0.187	14.8	0.211
CADMIUM (mg/kg)	9.6	1.88	0.196	1.84	0.192	0.563	0.059	0.532	0.055
CHROMIUM (mg/kg)	370	123	0.332	111	0.300	89.6	0.242	84.6	0.229
COPPER (mg/kg)	270	180	0.667	142	0.526	136 J	0.504	82.9	0.307
LEAD (mg/kg)	218	165 J	0.757	147 J	0.674	123 J	0.564	83.8	0.384
NICKEL (mg/kg)	51.6	56.0 J	1.085	35.60 J	0.690	28.95	0.561	25.46	0.493
SELENIUM (mg/kg)	1.4	0.885	0.632	0.794	0.567	0.722	0.516	0.727 J	0.519
ZINC (mg/kg)	410	405 J	0.988	281 J	0.685	261	0.637	199	0.485
TOTAL PCB CONGENERS (µg/kg)	180	512.98	2.861	430.32	2.402	115.95	0.655	92.18	0.523
ALPHA-CHLORDANE (µg/kg)	6	4.45	0.742	2.5	0.417	0.71 J	0.118	0.83	0.138
TOTAL DDT (µg/kg)	46.1	26.66	0.578	33.76	0.732	7.94	0.172	10.02	0.217
HIGH MOLECULAR WEIGHT PAHs (µg/kg)	9600	12141.99	1.265	8180.17	0.852	18370.83	1.914	18971.71	1.976
LOW MOLECULAR WEIGHT PAHs (µg/kg)	3160	2113.44	0.669	2007.32	0.635	2108.37	0.667	2623.9	0.830
Total ERM-Q			0.842		0.678		0.522		0.489

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-2

OUTER PIER 1 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 5

PARAMETER	ERM	OUTER PIER 1 P5 DAD-25 20041012		OUTER PIER 1 P6 DAD-26 20041012		OUTER PIER 1 TRP1-SD-003 TRP1-SD-003B-0001 20081107		OUTER PIER 1 TRP1-SD-003 TRP1-SD-003A-0204 20081107	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	15.3	0.219	14.1	0.201	15.00 J	0.214	5.10 J	0.073
CADMIUM (mg/kg)	9.6	0.41	0.043	0.439	0.046	0.650 J	0.068	0.730 J	0.076
CHROMIUM (mg/kg)	370	88.6	0.239	76.7	0.207	62.2 J	0.168	61.7 J	0.167
COPPER (mg/kg)	270	76.5	0.283	95.2 J	0.353	106 J	0.393	62.1 J	0.230
LEAD (mg/kg)	218	78.9	0.362	295 J	1.353	97.9 J	0.449	95.4 J	0.438
NICKEL (mg/kg)	51.6	26.48	0.513	26.03	0.504	26.60 J	0.516	12.70 J	0.246
SELENIUM (mg/kg)	1.4	0.805 J	0.575	0.833	0.595	4.7	3.357	2.4	1.714
ZINC (mg/kg)	410	183	0.446	218	0.532	212 J	0.517	221 J	0.539
TOTAL PCB CONGENERS (µg/kg)	180	184.46	1.036	73.11	0.417	248.6	1.381	111.4	0.619
ALPHA-CHLORDANE (µg/kg)	6	1.11	0.185	0.96 J	0.160	2.3 U	0.192	0.54 U	0.045
TOTAL DDT (µg/kg)	46.1	14.32	0.311	4.58	0.099	4.5	0.098	7.6	0.165
HIGH MOLECULAR WEIGHT PAHs (µg/kg)	9600	13751.38	1.432	23464.79	2.444	8270	0.861	3238	0.337
LOW MOLECULAR WEIGHT PAHs (µg/kg)	3160	2168.24	0.686	3164.18	1.001	1269	0.402	600	0.190
Total ERM-Q			0.486		0.608		0.663		0.372

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-2

OUTER PIER 1 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 4 OF 5

PARAMETER	ERM	OUTER PIER 1 TRP1-SD-004 TRP1-SD-004B-0001 20081107		OUTER PIER 1 TRP1-SD-004 TRP1-SD-004A-0204 20081107		OUTER PIER 1 TRP1-SD-004 TRP1-SD-004A-0406 20081107		OUTER PIER 1 TRP1-SD-005 TRP1-SD-005B-0001 20081107	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	13.80 J	0.197	12	0.171	7.9	0.113	8.3	0.119
CADMIUM (mg/kg)	9.6	0.650 J	0.068	2.30 J	0.240	1.30 J	0.135	0.380 J	0.040
CHROMIUM (mg/kg)	370	71.0 J	0.192	121 J	0.327	96.8 J	0.262	40.10 J	0.108
COPPER (mg/kg)	270	130 J	0.481	203 J	0.752	207 J	0.767	64.9 J	0.240
LEAD (mg/kg)	218	119 J	0.546	260 J	1.193	192 J	0.881	79.8 J	0.366
NICKEL (mg/kg)	51.6	27.50 J	0.533	28.00 J	0.543	17.70 J	0.343	16.40 J	0.318
SELENIUM (mg/kg)	1.4	6.5	4.643	5.2	3.714	3.7	2.643	1.8	1.286
ZINC (mg/kg)	410	230 J	0.561	418 J	1.020	324 J	0.790	108 J	0.263
TOTAL PCB CONGENERS (µg/kg)	180	60.8	0.338	335	1.861	124.5	0.692	89.6	0.498
ALPHA-CHLORDANE (µg/kg)	6	0.91 U	0.076	7 U	0.583	6.1 U	0.508	0.84 U	0.070
TOTAL DDT (µg/kg)	46.1	4.5	0.098	32	0.694	71	1.540	2.4	0.052
HIGH MOLECULAR WEIGHT PAHs (µg/kg)	9600	11330	1.180	9630	1.003	10017	1.043	12050	1.255
LOW MOLECULAR WEIGHT PAHs (µg/kg)	3160	1214	0.384	3918	1.240	3869	1.224	1710	0.541
Total ERM-Q			0.715		1.026		0.842		0.397

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-2

OUTER PIER 1 ERM-Q CALCULATIONS
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 5 OF 5

PARAMETER	ERM	OUTER PIER 1 TRP1-SD-005 TRP1-SD-005A-0204 20081107		OUTER PIER 1 TRP1-SD-005 TRP1-SD-005A-0406 20081107		OUTER PIER 1 TRP1-SD-006 TRP1-SD-006B-0001 20081107		OUTER PIER 1 TRP1-SD-006 TRP1-SD-006A-0203 20081107	
		RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO	RESULT	ERM_RATIO
ARSENIC (mg/kg)	70	10.2	0.146	8.7	0.124	12.90 J	0.184	12.80 J	0.183
CADMIUM (mg/kg)	9.6	0.470 J	0.049	1.30 J	0.135	0.480 J	0.050	1.00 J	0.104
CHROMIUM (mg/kg)	370	42.60 J	0.115	113 J	0.305	62.7 J	0.169	60.4 J	0.163
COPPER (mg/kg)	270	78.7 J	0.291	201 J	0.744	80.6 J	0.299	463 J	1.715
LEAD (mg/kg)	218	62.1 J	0.285	253 J	1.161	88.4 J	0.406	80.8 J	0.371
NICKEL (mg/kg)	51.6	18.90 J	0.366	51.3 J	0.994	25.80 J	0.500	28.70 J	0.556
SELENIUM (mg/kg)	1.4	1.5	1.071	3.5	2.500	5.90 U	2.107	4.50 U	1.607
ZINC (mg/kg)	410	111 J	0.271	669 J	1.632	156 J	0.380	341 J	0.832
TOTAL PCB CONGENERS (µg/kg)	180	175.5	0.975	43.8	0.243	234.2	1.301	62	0.344
ALPHA-CHLORDANE (µg/kg)	6	3.6 U	0.300	3.5 U	0.292	0.88 U	0.073	3.8 U	0.317
TOTAL DDT (µg/kg)	46.1	10.35	0.225	33.35	0.723	2.9	0.063	11.1	0.241
HIGH MOLECULAR WEIGHT PAHs (µg/kg)	9600	38680	4.029	63850	6.651	6596	0.687	31340	3.265
LOW MOLECULAR WEIGHT PAHs (µg/kg)	3160	3845	1.217	9800	3.101	1781	0.564	10600	3.354
Total ERM-Q			0.718		1.431		0.522		1.004

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-3

ZONE 4 COMPREHENSIVE ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 7

PARAMETER	ERM	ZONE-4 Z4-33 0 - 0.17 ft CAB-36 20030617	ZONE-4 Z4-36 0 - 0.17 ft CAB-39 20030617	ZONE-4 Z4-37 0 - 0.17 ft CAB-41 20030617	ZONE-4 Z4-39 0 - 0.17 ft CAB-43 20030617	ZONE-4 Z4-40 0 - 0.17 ft CAB-44 20030617	ZONE-4 Z4-42 0 - 0.17 ft CAB-46 20030618	ZONE-4 Z4-43 0 - 0.17 ft CAB-47 20030618	ZONE-4 Z4-44 0 - 0.17 ft CAB-48 20030618
Low Molecular Weight PAHs (µg/kg)									
2-METHYLNAPHTHALENE		62	79	56	110	74	280	43	24
ACENAPHTHENE		150	100	100	69	450	3300	56	63
ACENAPHTHYLENE		32	42	42	62	55	72	28	14
ANTHRACENE		840	440	1000	300	2000	2700	590	350
FLUORENE		240	160	260	140	650	1900	130	100
NAPHTHALENE		140	200	120	180	140	420	80	45
PHENANTHRENE		1900	1100	1600	790	4700	11054.61 D	950	710
LOW MOLECULAR WEIGHT PAHS	3160	3300	2200	3200	1700	8000	20000	1900	1300
High Molecular Weight PAHs (µg/kg)									
BENZO(A)ANTHRACENE		3000	2100	6000	1500	6500	8900	2300	1000
BENZO(A)PYRENE		2400	1400	2800	1300	2900	2800	1600	760
CHRYSENE		3600	2500	6200	1500	6600	9600	3000	1400
DIBENZO(A,H)ANTHRACENE		330	230	320	200	340	280	200	110
FLUORANTHENE		6800	7100	14468.25 D	2400	17289.14 D	38620.01 D	3300	2400
PYRENE		6600	6300	9918.92 D	3200	11408.12 D	24456.92 D	4300	2000
HIGH MOLECULAR WEIGHT PAHS	9600	23000	20000	40000	10000	45000	85000	15000	7600
Pesticides/PCBs (µg/kg)									
4,4'-DDD		4.4	39	4.4	14	4.0	4.1	3.5	1.9
4,4'-DDE		3.3	17	4.3	7.4	4.1	4.2	3.6	1.7
4,4'-DDT		0.99	0.71	1.3	0.49 J	1.0	1.1	0.74 J	0.38 J
TOTAL DDT	46.1	8.7	56	10	22	9.1	9.3	7.8	4.0
PCB-8		0.58 U	0.58 U	0.89 U	0.69 U	0.88 U	1.11 U	0.84 U	0.52 U
PCB-18		31	30	7.3	5.5	3.9	3.9	2.7	1.4
PCB-28		36	42	10	6.0	6.6	5.0	4.7	2.3
PCB-44		11	31	5.3	7.9	3.9	4.2	3.5	1.7
PCB-52		15	46	5.9	9.7	3.7	4.0	3.7	1.9
PCB-66		7.1	30	5.1	7.2	4.3	4.1	4.3	2.5
PCB-101		6.5	71	4.3	10	4.1	4.1	3.6	1.9
PCB-105		2.9	26	3.1	5.5	3.2	4.4	3.3	1.5
PCB-118		5.5	56	4.5	9.0	4.0	3.9	4.1	2.0
PCB-128		0.35 U	0.35 U	0.54 U	0.42 U	0.53 U	0.67 U	0.51 U	0.31 U
PCB-138		6.0	59	4.0	9.7	3.3	2.8	3.8	1.9
PCB-153		8.7	66	5.4	12	4.5	3.6	4.7	2.4
PCB-170		3.3	14	2.3	3.0	1.9	1.9	2.3	1.1
PCB-180		5.6	24	3.8	6.2	2.7	3.1	2.8	1.4
PCB-187		3.9	12	2.8	4.0	2.0	2.6	2.1	1.2
PCB-195		2.0	4.9	1.8	4.0	1.5	1.5	1.4	0.63
PCB-206		2.8	6.2	2.4	7.5	2.1	2.1	2.0	0.92
PCB-209		2.6	4.0	5.2	8.0	3.5	4.2	2.8	1.1
TOTAL PCB CONGENERS	180	300	1000	150	230	110	110	100	53
ALPHA-CHLORDANE	6	0.75	6.1	0.66 J	0.96	0.64 J	0.60 J	0.59 J	0.33 J
Inorganics (mg/kg)									
ARSENIC	70	13.2	10.7	14.4	10.7	14.1	14.9	11.2	11.3
CADMIUM	9.6	1.6	3.5	0.67	1.4	0.56	0.52	0.44	0.3
CHROMIUM	370	263 B	364 B	98.2 B	125 B	98.8 B	101 B	93.5 B	71.1 B
COPPER	270	305	628	103	98.6	88.6	94.4	101	147
LEAD	218	345	1240	102	109	126	95.2	88.1	124
NICKEL	51.6	90.6	188	28.9	25.9	28.9	30.0	27.2	38.1
SELENIUM	1.4	1.1	2.2	0.92	0.89	0.93	1.0	0.81	0.66
ZINC	410	3310 B	4070 B	194 B	182 B	171 B	170 B	191 B	958 B

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-3

ZONE 4 COMPREHENSIVE ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 7

PARAMETER	**ERM**	ZONE-4 Z4-46 0 - 0.17 ft CAB-50 20030618	ZONE-4 Z4-C1 2 - 4 ft DAD-8-0204 20041011	ZONE-4 Z4-C1 4 - 5 ft DAD-8-0405 20041011	ZONE-4 Z4-C1 5.5 - 7.25 ft DAD-8-0507 20041011	ZONE-4 Z4-C2 2 - 4 ft DAD-9-0204 20041011	ZONE-4 Z4-C2 4 - 5.41 ft DAD-9-0405 20041011	ZONE-4 Z4-S1 0 - 1 ft DAD-1 20041012	ZONE-4 Z4-S2 0 - 1 ft DAD-2 20041013
Low Molecular Weight PAHs (µg/kg)									
2-METHYLNAPHTHALENE		110	90	110	0.10 J	9	5	56	45
ACENAPHTHENE		39	400	510	0.91 J	6	3	310	840
ACENAPHTHYLENE		39	220	260	0.12 J	21	8	210	150
ANTHRACENE		320	2000	990	0.20 J	41	18	1200	1400
FLUORENE		80	260	290	0.18 J	13	6	370	390
NAPHTHALENE		190	190	220	0.36 J	25	19	280	84
PHENANTHRENE		610	1500	1800	0.35 J	68	31	2500	3200
LOW MOLECULAR WEIGHT PAHS	3160	1400	4600	4100	2	180	90	4900	6100
High Molecular Weight PAHs (µg/kg)									
BENZO(A)ANTHRACENE		960	3600	3000	0.47 J	130	39	3500	3000
BENZO(A)PYRENE		1100	2300	2200	0.43 J	190	71	2100	2400
CHRYSENE		1200	4100	3300	0.65 J	150	54	5000	3900
DIBENZO(A,H)ANTHRACENE		160	290	280	0.29 J	29	12	260	320
FLUORANTHENE		1500	8700	12000	1.29 J	200	73	11000	9200
PYRENE		2100	6600	9000	1.47 J	690	270	7500	6100
HIGH MOLECULAR WEIGHT PAHS	9600	7000	26000	30000	5	1400	520	29000	25000
Pesticides/PCBs (µg/kg)									
4,4'-DDD		2.0	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE		1.1	8.6	11	0.06 UJ	0.82	0.34	2.5	3.3
4,4'-DDT		0.52	2.1	2.2	0.06 UJ	0.14	0.07	2.7	1.9
TOTAL DDT	46.1	3.7	11	13	0.06	0.96	0.41	5.2	5.2
PCB-8		0.57 U	3.52 NJ	11.17 NJ	0.08 UJ	0.41 NJ	0.22 NJ	1.29 NJ	0.25 U
PCB-18		1.3	6.1	27	0.06 UJ	1.1	0.47	2.3	15
PCB-28		1.6	11	31	0.06 UJ	2.0	0.84	3.7	17
PCB-44		2.1	8.8	17	0.05 UJ	1.8	0.81	3.5	6.8
PCB-52		2.7	9.6	22	0.06 UJ	2.3	0.98	2.4	7.4
PCB-66		2.1	12	18	0.07 UJ	2.4	1.1	3.8	7.0
PCB-101		2.1	11	16	0.07 UJ	3.0	1.2	2.1	3.4
PCB-105		2.3	3.4	4.9	0.05 UJ	1.0	0.44	0.82	1.9
PCB-118		2.0	9.2	13	0.07 UJ	2.0	0.89	1.7	2.9
PCB-128		0.34 U	4.1	5.8	0.05 UJ	0.74	0.35	1.3	1.4
PCB-138		2.3	9.2	14	0.07 UJ	2.1	0.88	1.8	3.6
PCB-153		2.8	13	19	0.08 UJ	2.5	1.1	2.5	4.9
PCB-170		1.4	2.3	4.2	0.07 UJ	0.49	0.15	0.71	1.7
PCB-180		2.3	5.2	9.0	0.07 UJ	0.99	0.46	1.1	2.8
PCB-187		1.8	4.3	6.5	0.06 UJ	0.68	0.31	0.91	2.2
PCB-195		2.7	NA	NA	NA	NA	NA	NA	NA
PCB-206		5.5	2.6	4.4	0.07 UJ	0.48	0.29	0.31	0.76
PCB-209		4.6	3.8	5.0	0.07 UJ	0.56	0.38	0.95	1.2
TOTAL PCB CONGENERS	180	80	240	450	1.1	49	22	63	160
ALPHA-CHLORDANE	6	0.20 J	2.0	3.3	0.05 UJ	0.31	0.11	0.68	0.9
Inorganics (mg/kg)									
ARSENIC	70	8.1	14.2	12.5	0.094	2.6	1.2	13.2	13.9
CADMIUM	9.6	0.36	1.3	1.7	0.029	0.31	0.14	0.21	0.58
CHROMIUM	370	83.7 B	112	127	14.6	28.4	22.4	61.5	84.6
COPPER	270	64.1	128	129	2.8	21.8	15.5	255	97.3 J
LEAD	218	69.7	149 J	162 J	1.79 J	31.46 J	26.60 J	54.9	102 J
NICKEL	51.6	19.1	36.90 J	43.18 J	3.70 J	10.71 J	6.76 J	14.3	26.4
SELENIUM	1.4	0.53	0.91	0.75	0.020 U	0.11	0.031	0.396 J	0.8
ZINC	410	109 B	275 J	351 J	12.58 J	67.6 J	37.64 J	3710	321

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-3

ZONE 4 COMPREHENSIVE ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 7

PARAMETER	ERM	ZONE-4 Z4-S3 0 - 1 ft DAD-3 20041013	ZONE-4 Z4-S4 0 - 1 ft DAD-4 20041013	ZONE-4 Z4-S5 0 - 1 ft DAD-5 20041012	ZONE-4 Z4-S6 0 - 1 ft DAD-6 20041012	ZONE-4 Z4-S6R 0 - 1 ft DAD-6-D 20041012	ZONE-4 Z4-1 0 - 0.17 ft GAB-001 20070426	ZONE-4 Z4-2 0 - 0.17 ft GAB-002 20070425	ZONE-4 Z4-3 0 - 0.17 ft GAB-003 20070426
Low Molecular Weight PAHs (µg/kg)									
2-METHYLNAPHTHALENE		63	57	56	48	77	83.28 J	65	150
ACENAPHTHENE		1100	960	60	39	59	340	230	1400
ACENAPHTHYLENE		240	190	160	100	100	280	100	140
ANTHRACENE		2000	1100	950	420	500	2388.42 J	660	1000
FLUORENE		620	710	180	85	120	710	210	950
NAPHTHALENE		120	92	88	76	100	130	160	510
PHENANTHRENE		6400	4600	1100	520	720	3900	1200	3200
LOW MOLECULAR WEIGHT PAHS	3160	11000	7800	2600	1300	1700	7900	2600	7300
High Molecular Weight PAHs (µg/kg)									
BENZO(A)ANTHRACENE		7300	4100	2700	1300	1600	4700	2200	1800
BENZO(A)PYRENE		2900	2100	1700	1100	1300	3600	1500	1400
CHRYSENE		7600	4300	3500	1500	1700	5600	2600	1800
DIBENZO(A,H)ANTHRACENE		380	270	230	180	190	703.34 J	270	210
FLUORANTHENE		18000	10000	7100	2100	2500	9800	6100	6700
PYRENE		12314.22 J	9491.93 J	5100	2900	4100	10000	5800	5800
HIGH MOLECULAR WEIGHT PAHS	9600	48000	31000	20000	9100	12000	34000	18000	18000
Pesticides/PCBs (µg/kg)									
4,4'-DDD		NA	NA	NA	NA	NA	2.3	10	3.3
4,4'-DDE		3.43 J	3.2	3.8	5.0	7.5	5.1	13	5.7
4,4'-DDT		0.15 U	1.1	2.7	3.0	5.7	2.5	3.5	3.0
TOTAL DDT	46.1	3.5	4.3	6.5	8.0	13	9.9	27	12
PCB-8		2.75 NJ	0.23 U	1.81 NJ	0.61 NJ	0.14 U	13	10	7.7
PCB-18		6.36 J	1.9	2.3	1.6	2.6	14	16	6.3
PCB-28		9.03 J	4.2	5.1	3.0	3.7	15	18	9.7
PCB-44		6.14 J	3.4	3.8	4.9	7.7	7.3	15	6.0
PCB-52		5.21 J	2.9	3.6	8.8	15	9.6	17	8.6
PCB-66		1.96 J	5.6	5.8	4.5	6.6	6.8	16	6.5
PCB-101		4.01 J	3.3	3.7	14	30	13	18	9.6
PCB-105		3.39 J	3.4	1.5	4.2	8.0	1.8	6.9	1.9
PCB-118		2.38 J	2.5	3.5	10	17	5.4	16	6.0
PCB-128		1.24 J	1.4	1.7	3.2	5.5	2.6	4.0	3.4
PCB-138		2.53 J	2.6	3.7	11	22	6.5	15	6.8
PCB-153		3.15 J	3.1	4.7	15	36	9.1	14	8.8
PCB-170		0.95 J	0.82	1.1	1.9	6.1	2.5	3.9	2.3
PCB-180		1.87 J	1.6	2.4	3.5	15	4.5	7.6	4.3
PCB-187		1.67 J	1.5	2.2	2.6	10	3.4	5.3	3.2
PCB-195		NA	NA	NA	NA	NA	0.03 U	0.03 U	0.03 U
PCB-206		0.92 J	0.88	1.1	1.9	3.9	0.03 UJ	0.03 UJ	0.03 UJ
PCB-209		1.06 J	1.3	2.2	2.6	2.7	0.03 UJ	0.03 UJ	0.03 UJ
TOTAL PCB CONGENERS	180	110	81	100	190	380	230	370	180
ALPHA-CHLORDANE	6	0.84 J	0.59	0.94	0.88	0.94	0.8	2.5	0.73
Inorganics (mg/kg)									
ARSENIC	70	12.6	13.5	12.7	7.4	5.6	12.5	10.5	13.9
CADMIUM	9.6	0.54	0.52	0.49	0.91	0.96	0.83	2.8	1.1
CHROMIUM	370	85.7	88.0	88.1	53.9	87.7	321	313	105
COPPER	270	95.2 J	85.0 J	83.6	59.9	132 J	568	735	121
LEAD	218	93.9 J	89.4 J	84.5	119	131 J	524	841	136
NICKEL	51.6	26.6	27.7	26.1	17.0	24.8	165	286	32.3
SELENIUM	1.4	0.61	0.68	0.747 J	0.428 J	0.5	1.3	1.9	1.1
ZINC	410	255	202	191	216	468	3070	3720	234

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-3

ZONE 4 COMPREHENSIVE ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 4 OF 7

PARAMETER	**ERM**	ZONE-4 Z4-4 0 - 0.17 ft GAB-004 20070426	ZONE-4 Z4-4 0 - 0.17 ft GAB-004-D 20070426	ZONE-4 Z4-5 0 - 0.17 ft GAB-005 20070425	ZONE-4 Z4-6 0 - 0.17 ft GAB-006 20070425	ZONE-4 TRZ4-SD-001 2 - 4 ft TRZ4-SD-001A-0204 20081106	ZONE-4 TRZ4-SD-001 4 - 6 ft TRZ4-SD-001A-0406 20081106	ZONE-4 TRZ4-SD-001 0 - 1 ft TRZ4-SD-001B-0001 20081106	ZONE-4 TRZ4-SD-002 2 - 4 ft TRZ4-SD-002A-0204 20081106
Low Molecular Weight PAHs (µg/kg)									
2-METHYLNAPHTHALENE		140	87	46	76	150	280	40	68
ACENAPHTHENE		960	570	85	210	1800	6400	80	220
ACENAPHTHYLENE		120	82	110	89	790	430	230	170
ANTHRACENE		720	490	640	420	3900	3800	470	1700
FLUORENE		530	320	150	190	1300	1800	120	380
NAPHTHALENE		370	270	91	110	580	930	98	66
PHENANTHRENE		2400	1200	1100	930	5800	6400	800	4300
LOW MOLECULAR WEIGHT PAHS	3160	5200	3000	2300	2000	14000	20000	1800	6900
High Molecular Weight PAHs (µg/kg)									
BENZO(A)ANTHRACENE		1800	1200	1600	1100	8700	4600	1200	4600
BENZO(A)PYRENE		1200	930	1200	1000	4500	2200	1100	3800
CHRYSENE		1700	1200	1800	1300	9800	5200	1800	5300
DIBENZO(A,H)ANTHRACENE		220	140	160	160	680 J	340	170	510
FLUORANTHENE		6400	4000	4400	2600	36000	26000	3100	12000
PYRENE		5600	3500	4500	2900	24000	17000	3700	11000
HIGH MOLECULAR WEIGHT PAHS	9600	17000	11000	14000	9100	84000	55000	11000	37000
Pesticides/PCBs (µg/kg)									
4,4'-DDD		3.4	2.2	2.1	1.8	6.7 UJ	7 J	1.8 U	68 U
4,4'-DDE		5.8	4.1	3.4	3.1	6.7 UJ	13	3.6 J	68 U
4,4'-DDT		2.3	2.2	2.5	1.7	6.7 UJ	6.7 UJ	7.5 J	68 U
TOTAL DDT	46.1	11	8.5	8.0	6.7	10	23	12	100
PCB-8		5.0	3.1	2.1	1.9	14 J	22 J	5.7	29 J
PCB-18		4.0	2.3	1.4	1.3	32 J	43 J	8.7	55 J
PCB-28		7.9	4.7	3.7	3.1	36 J	42 J	13 J	48 J
PCB-44		6.4	3.8	2.9	2.8	11 J	12 J	6.3	17 J
PCB-52		9.3	4.8	3.3	2.9	22	23	8 J	29
PCB-66		6.7	5.2	3.4	3.7	7.8 R	10 J	2.6 U	14 J
PCB-101		11	6.3	6.2	6.1	14	11 J	7.5 J	27
PCB-105		2.5	1.4	1.3	1.3	5.3 J	4.3 J	2.6 U	2.6 R
PCB-118		7.5	4.2	3.6	3.3	12 J	13 J	8 J	40 R
PCB-128		3.1	1.6	1.9	1.8	2.6 U	2.4 U	2.6 U	2.1 U
PCB-138		8.5	4.4	4.2	4.0	12 J	13 J	6.8 J	21 J
PCB-153		10	5.2	4.5	4.2	12	12 J	6.5	24
PCB-170		2.0	1.1	1.7	1.1	2.6 U	2.4 U	8.1 J	3.9 R
PCB-180		4.6	2.4	2.4	2.2	10	9.8	4.3 J	22 J
PCB-187		3.3	2.0	2.1	1.8	2.8 R	2.4 UJ	2.6 UJ	7.7 J
PCB-195		0.03 U	0.03 U	0.03 U	0.03 U	2.6 U	2.4 U	6.3	2.9 J
PCB-206		0.03 UJ	0.03 UJ	0.03 UJ	0.03 UJ	5.6	5 J	9.6	7.3 J
PCB-209		0.03 UJ	0.03 UJ	0.03 UJ	0.03 UJ	2.6 U	2.4 U	4.9 R	2.1 U
TOTAL PCB CONGENERS	180	180	110	90	83	380	450	210	610
ALPHA-CHLORDANE	6	0.94	0.61	0.64	0.57	3.4 UJ	3.5 U	0.92 U	35 U
Inorganics (mg/kg)									
ARSENIC	70	13.0	13.2	13.8	11.0	15.20 J	16.40 J	13.90 J	15.7
CADMIUM	9.6	0.91	0.93	0.65	0.5	2.00 J	2.20 J	0.620 J	1.4
CHROMIUM	370	100	99.7	86.6	79.3	155 J	129 J	77.7 J	86.3
COPPER	270	115	112	198	84.0	372 J	266 J	132 J	162 J
LEAD	218	112	119	106	78.6	483 J	308 J	202 J	178 J
NICKEL	51.6	32.0	32.5	30.0	27.6	89.2	72.7	30.1	29.70 J
SELENIUM	1.4	0.94	0.85	0.88	0.72	5.7	6.6	6.0	5.5
ZINC	410	218	209	766	163	2110 J	652 J	264 J	323 J

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-3

ZONE 4 COMPREHENSIVE ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 5 OF 7

PARAMETER	ERM	ZONE-4 TRZ4-SD-002 4 - 6 ft TRZ4-SD-002A-0406 20081106	ZONE-4 TRZ4-SD-002 0 - 1 ft TRZ4-SD-002B-0001 20081106	ZONE-4 TRZ4-SD-003 2 - 4 ft TRZ4-SD-003A-0204 20081106	ZONE-4 TRZ4-SD-003 4 - 6 ft TRZ4-SD-003A-0406 20081106	ZONE-4 TRZ4-SD-003 0 - 1 ft TRZ4-SD-003B-0001 20081106	ZONE-4 TRZ4-SD-004 2 - 4 ft TRZ4-SD-004A-0204 20081107	ZONE-4 TRZ4-SD-004 4 - 6 ft TRZ4-SD-004A-0406 20081107	ZONE-4 TRZ4-SD-004 0 - 1 ft TRZ4-SD-004B-0001 20081107
Low Molecular Weight PAHs (µg/kg)									
2-METHYLNAPHTHALENE		170 J	35	43	65	26	60	210	8
ACENAPHTHENE		520	350	300	800	140	93	1500	35
ACENAPHTHYLENE		120 J	270	260	180	160	120	350	83
ANTHRACENE		430	680	720	1100	440	320	1400	130
FLUORENE		400	200	190	310	95	89	690	53
NAPHTHALENE		320 J	92	61 J	160	33	210	340	14
PHENANTHRENE		1000	1400	810	1700	520	280	2400	320
LOW MOLECULAR WEIGHT PAHS	3160	3000	3000	2400	4300	1400	1200	6900	640
High Molecular Weight PAHs (µg/kg)									
BENZO(A)ANTHRACENE		470	2200	2600	1900	1800	890	3300	350
BENZO(A)PYRENE		360	1600	1500	1300	1200	620	2100	360
CHRYSENE		500	3100	2400	1900	1600	870	3200	570
DIBENZO(A,H)ANTHRACENE		69	230	200	130	150	74	220	57
FLUORANTHENE		2100	6500	8200	7700	5200	3100	12000	990
PYRENE		1600	6600	6000	5700	4100	3300	8200	1100
HIGH MOLECULAR WEIGHT PAHS	9600	5100	20000	21000	19000	14000	8900	29000	3400
Pesticides/PCBs (µg/kg)									
4,4'-DDD		35 U	34 U	86 U	11 U	75 U	2.4 J	9.9 J	0.9 U
4,4'-DDE		97 J	34 U	86 U	23 J	75 U	1.8 J	14 J	0.52 J
4,4'-DDT		130 J	44	86 UJ	11 UJ	75 UJ	4.2 J	13 J	0.9 UJ
TOTAL DDT	46.1	240	78	130	34	110	8.4	37	1.4
PCB-8		84	7.8	16	14 J	7.7 J	2.9	16 J	2.4 J
PCB-18		140 J	20 J	36 J	27 J	22 J	4.9 J	29 J	2.5
PCB-28		150 J	20 J	46 J	28 J	28 J	5 J	31 J	1.7 R
PCB-44		51	13 J	15 J	10 J	8 J	2.1 J	12 J	4 J
PCB-52		63	24	21 J	15 J	10 J	5 J	21	1.7 R
PCB-66		36 J	2 U	13 J	6.8 J	8.9 J	1.3 U	14 J	1.4 U
PCB-101		28 J	28	11 J	11 J	6.2 J	5.5	21 J	3.3 J
PCB-105		11 J	10 J	4.2 J	2.7 J	2.9 J	1.3 U	2.5 R	1.4 U
PCB-118		50 R	43 J	20 J	11 J	6.8 J	4.4	16 J	2.5 J
PCB-128		2.1 U	4.4 J	2.6 U	1.7 U	2.2 U	1.3 U	2 R	1.4 U
PCB-138		33 J	22	12 J	8.7 J	6.9 J	6.1 J	17 J	1.7
PCB-153		36	19	14	9.8	7.8	5.4	18 J	1.6 J
PCB-170		23 J	6.4	2.6 R	7.6 J	2.4 R	1.3 U	4.8 R	1.4 U
PCB-180		33	6.0	8.5 J	7.6 J	5.1 J	3.2	21 J	1.4 U
PCB-187		9.6 J	3.2 J	5.2 J	3.2 J	2.2 U	1.3 U	5.5 J	1.4 U
PCB-195		4.3 J	2 U	2.6 U	1.7 U	2.2 U	1.3 U	1.7 U	1.4 U
PCB-206		9.3 J	2.3 J	5 J	6.6 J	5.1 J	3.0	5.2	3.4 J
PCB-209		3.6 R	4.0	4.8 J	1.5 R	2.8 J	1.7 J	2.5 J	4.1 J
TOTAL PCB CONGENERS	180	1400	470	470	340	260	110	460	61
ALPHA-CHLORDANE	6	18 U	17 U	44 UJ	5.8 U	38 U	0.46 J	2.3	0.47 U
Inorganics (mg/kg)									
ARSENIC	70	12.3	11.1	17.2	6.6	13.4	4.70 J	10.90 J	4.10 J
CADMIUM	9.6	2.4	0.9	0.83	0.62	0.61	0.470 J	1.50 J	0.190 J
CHROMIUM	370	128	81.7	85.1	76.9	66.5	52.4 J	85.3 J	40.20 J
COPPER	270	171 J	183 J	132 J	174 J	109 J	92.1 J	165 J	100 J
LEAD	218	187 J	223 J	162 J	206 J	108 J	157 J	400 J	127 J
NICKEL	51.6	30.10 J	41.50 J	30.80 J	58.1 J	25.20 J	28.10 J	24.70 J	40.50 J
SELENIUM	1.4	6.1	5.0	6.2	4.0	5.0	2.6	4.7	2.6
ZINC	410	292 J	523 J	242 J	665 J	239 J	273 J	256 J	359 J

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-3

**ZONE 4 COMPREHENSIVE ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 6 OF 7**

PARAMETER	ERM	ZONE-4 TRZ4-SD-005 2 - 4 ft TRZ4-SD-005A-0204 20081106	ZONE-4 TRZ4-SD-005 4 - 6 ft TRZ4-SD-005A-0406 20081106	ZONE-4 TRZ4-SD-005 0 - 1 ft TRZ4-SD-005B-0001 20081106	ZONE-4 TRZ4-SD-006 2 - 4 ft TRZ4-SD-006A-0204 20081106	ZONE-4 TRZ4-SD-006 4 - 6 ft TRZ4-SD-006A-0406 20081106	ZONE-4 TRZ4-SD-006 0 - 1 ft TRZ4-SD-006B-0001 20081106	ZONE-4 TRZ4-SD-007 2 - 4 ft TRZ4-SD-007A-0204 20081106	ZONE-4 TRZ4-SD-007 4 - 6 ft TRZ4-SD-007A-0406 20081106
Low Molecular Weight PAHs (µg/kg)									
2-METHYLNAPHTHALENE		67	1400	15	24	34	25	6.9 U	6.7 U
ACENAPHTHENE		540	9900	25	200	68	59	6.9 U	6.7 U
ACENAPHTHYLENE		230	390 J	160	110	77	140	14	6.7 U
ANTHRACENE		1700	2600	320	270	310	400	27	6.7 U
FLUORENE		500	6800	65	95	66	99	7	6.7 U
NAPHTHALENE		100	3400	33	42	130	63	9	6.7 U
PHENANTHRENE		1100	17000	320	510	270	630	27	6.7 U
LOW MOLECULAR WEIGHT PAHS	3160	4200	41000	940	1300	960	1400	91	23
High Molecular Weight PAHs (µg/kg)									
BENZO(A)ANTHRACENE		1700	3200	1200	570	800	1400	74	6.7 U
BENZO(A)PYRENE		1000	1700	920	470	430	940	83	6.7 U
CHRYSENE		2300	3700	1300	590	780	1500	99	6.7 U
DIBENZO(A,H)ANTHRACENE		150	110	130	75	76	140	15	6.7 U
FLUORANTHENE		4500	19000	2300	2500	2700	3300	160	10
PYRENE		4500	12000	2900	2000	2300	4300	240	12
HIGH MOLECULAR WEIGHT PAHS	9600	14000	40000	8800	6200	7100	12000	670	35
Pesticides/PCBs (µg/kg)									
4,4'-DDD		16 U	38 U	43 U	90 U	27 U	50 U	6.8 U	6.6 U
4,4'-DDE		27	42 J	43 U	90 U	27 U	50 U	6.8 U	6.6 U
4,4'-DDT		150 J	38 UJ	45 J	90 UJ	36 J	50 UJ	6.8 U	6.6 U
TOTAL DDT	46.1	190	80	88	140	63	75	10	9.9
PCB-8		13 J	46 J	9.3 J	28	80	3.9 J	2.1 U	2 U
PCB-18		27 J	84 J	23 J	67 J	130 J	4.6 R	2.1 U	2 U
PCB-28		33 J	80 J	35 J	97 J	120 J	27 J	2.1 UJ	2 UJ
PCB-44		9.4 J	27 J	21	28 J	40	11 J	2.1 U	2 U
PCB-52		12 J	63 J	15 J	51	48	13 J	2.1 U	2 U
PCB-66		7.1 J	2.3 UJ	13 J	14 R	28 J	7.1 R	2.1 UJ	2 UJ
PCB-101		9.1 J	72 J	9.9 J	26 J	22 J	10 J	2.1 U	2 U
PCB-105		3 J	11 R	3.7 J	9.3 J	3.9 R	2.9 U	2.1 U	2 U
PCB-118		8.7 J	59 J	7.7	16 J	11 R	8 J	2.1 U	2 U
PCB-128		2.3 U	10 J	2.6 U	2.9 R	1.6 U	2.9 U	2.1 U	4.9 J
PCB-138		9.5 J	70 J	9.5 J	22 J	19 J	8.5	2.1 U	2 U
PCB-153		9.9	76	8.3 J	23	25	6.7	2.1 U	2 U
PCB-170		7.1 J	18 J	2.6 U	5.3 R	17 J	2.9 U	2.1 U	2 U
PCB-180		5.2 J	27	4.8 J	12 J	21	4.1 J	2.1 U	2 U
PCB-187		2.4 J	13 J	2.6 U	3.7 R	12 J	2.9 U	2.1 U	2 U
PCB-195		2.3 U	3.3	2.6 U	2.8 U	2.7 J	2.9 U	2.1 U	2 U
PCB-206		5.5	7.9	4.6 J	5.6 J	9.9	6.9 J	2.1 U	2.2 J
PCB-209		4 J	2.3 U	3 J	2.8 U	6 J	7.4	2.4	2 U
TOTAL PCB CONGENERS	180	340	1300	350	780	1200	230	41	46
ALPHA-CHLORDANE	6	8 U	20 U	22 U	46 U	14 U	26 U	3.5 U	3.4 U
Inorganics (mg/kg)									
ARSENIC	70	16.1	13.2	17.1	16.8	8.1	13.9	9.3	8.6
CADMIUM	9.6	1.1	1.9	0.81	2.6	1.3	0.61	0.25	0.25
CHROMIUM	370	115	109	81.0	134	72.9	69.7	38.1	36.8
COPPER	270	348 J	212 J	144 J	202 J	113 J	104 J	27.10 J	14.50 J
LEAD	218	248 J	288 J	158 J	197 J	147 J	101 J	21.20 J	7.60 J
NICKEL	51.6	61.1 J	34.80 J	30.00 J	46.90 J	20.80 J	26.90 J	20.90 J	21.30 J
SELENIUM	1.4	6.7	5.7	6.7	6.7	3.8	6.3	4.3	5.5
ZINC	410	730 J	367 J	240 J	353 J	209 J	185 J	68.9 J	52.4 J

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-3

ZONE 4 COMPREHENSIVE ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 7 OF 7

PARAMETER	ERM	ZONE-4 TRZ4-SD-007 0 - 1 ft TRZ4-SD-007B-0001 20081106	ZONE-4 TRZ4-SD-008 2 - 4 ft TRZ4-SD-008A-0204 20081106	ZONE-4 TRZ4-SD-008 4 - 6 ft TRZ4-SD-008A-0406 20081106	ZONE-4 TRZ4-SD-008 0 - 1 ft TRZ4-SD-008B-0001 20081106
Low Molecular Weight PAHs (µg/kg)					
2-METHYLNAPHTHALENE		39 J	22	43	29
ACENAPHTHENE		85	49	300	33
ACENAPHTHYLENE		240 J	130	200	140
ANTHRACENE		540	300	400	260
FLUORENE		130	68	190	60
NAPHTHALENE		190 J	28	57	67
PHENANTHRENE		500	380	680	310
LOW MOLECULAR WEIGHT PAHS	3160	1700	980	1900	900
High Molecular Weight PAHs (µg/kg)					
BENZO(A)ANTHRACENE		1800	740	1100	700
BENZO(A)PYRENE		1200	510	640	640
CHRYSENE		2100	740	730	730
DIBENZO(A,H)ANTHRACENE		180	88	110	110
FLUORANTHENE		3100	3300	4000	1300
PYRENE		5400	2500	3100	2400
HIGH MOLECULAR WEIGHT PAHS	9600	14000	7900	9700	5900
Pesticides/PCBs (µg/kg)					
4,4'-DDD		46 U	88 U	18 J	9.7 U
4,4'-DDE		46 U	88 U	36 J	11 J
4,4'-DDT		68 J	88 UJ	35 J	9.7 UJ
TOTAL DDT	46.1	110	130	89	21
PCB-8		9.9	3.6 J	12 J	2.9 U
PCB-18		15 J	12 J	14 J	4.5 R
PCB-28		16 J	20 J	25 J	22 J
PCB-44		6.7	7.9 J	9.4 J	11 J
PCB-52		11	9.7 J	17 J	11 J
PCB-66		2.8 UJ	16 J	9 J	2.9 UJ
PCB-101		9.2 J	12 J	13 J	6.9 J
PCB-105		3.3 J	2.9 J	3.7 J	2.9 U
PCB-118		7.6 J	19 J	14 J	17 J
PCB-128		2.8 U	2.6 U	2.6 U	2.9 U
PCB-138		8.5	10 J	14 J	7.3
PCB-153		8.6	12	13	7.3
PCB-170		8.7 J	2.8 R	2.6 U	3.1 R
PCB-180		5.7	6.5	7.3	4.4 J
PCB-187		2.8 U	2.6 U	2.6 U	2.9 U
PCB-195		2.8 U	2.6 U	2.6 U	2.9 U
PCB-206		8.3	4.7	5.9 J	3.8 J
PCB-209		3.7 R	2.6 U	2.6 U	2.9 U
TOTAL PCB CONGENERS	180	250	280	330	200
ALPHA-CHLORDANE	6	24 U	45 U	6 J	5 U
Inorganics (mg/kg)					
ARSENIC	70	16.4	15.3	17.0	14.3
CADMIUM	9.6	0.81	0.99	1.4	0.7
CHROMIUM	370	91.5	86.1	100	76.9
COPPER	270	165 J	141 J	166 J	118 J
LEAD	218	148 J	122 J	148 J	105 J
NICKEL	51.6	35.00 J	36.50 J	39.70 J	29.00 J
SELENIUM	1.4	6.5	6.6	5.7	6.3
ZINC	410	224 J	211 J	260 J	206 J

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-4

OUTER PIER 1 COMPREHENSIVE SEDIMENT ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 1 OF 3

PARAMETER	ERM	OUTER PIER 1 SBP-5 0 - 0.5 ft SBP-5-GRAB 19991028	OUTER PIER 1 SBP-6 0 - 0.5 ft SBP-6-GRAB 19991028	OUTER PIER 1 P1-53 0 - 0.17 ft CAB-59 20030617	OUTER PIER 1 P1-55 0 - 0.17 ft CAB-61 20030617	OUTER PIER 1 P1-C5 2.0 - 4.0 ft DAD-31-0204 20041011	OUTER PIER 1 P1-C5 4.0 - 6.0 ft DAD-31-0406 20041011	OUTER PIER 1 P4 0 - 1.0 ft DAD-23 20041012
Low Molecular Weight PAHs (µg/kg)								
2-METHYLNAPHTHALENE		10	10	38.23	34.64	86.52	83.48	41.23
ACENAPHTHENE		17	16	29.04	22.79	111.71	127.88	40.27
ACENAPHTHYLENE		81	55	27.7	21.73	151.18	83.75	175.84
ANTHRACENE		250	180	334.34	239.39	447.88	474.39	806
FLUORENE		29	24	67.58	48.49	201.38	224.3	110.99
NAPHTHALENE		38	21	63.81	55.34	129.53	136.18	81.95
PHENANTHRENE		370	360	596.82	400.77	985.24	877.34	852.09
LOW MOLECULAR WEIGHT PAHS	3160	795	666	1157.52	823.15	2113.44	2007.32	2108.37
High Molecular Weight PAHs (µg/kg)								
BENZO(A)ANTHRACENE		630	430	1270.48	742.9	1325.63	908.78	2810.79
BENZO(A)PYRENE		610	390	1195.76	722.2	1374.96	828.52	2472.81
CHRYSENE		730	850	1735.59	1025.88	1692.79	1047.95	4328.2
DIBENZO(A,H)ANTHRACENE		89	58	198.53	117.51	216.24	137.37	376.36
FLUORANTHENE		1200	990	2169.83	1592.9	3997.81	2604.65	4095.51
PYRENE		810	790	1918.82	1314.09	3534.56	2652.9	4287.16 J
HIGH MOLECULAR WEIGHT PAHS	9600	4069	3508	8489.01	5515.48	12141.99	8180.17	18370.83
Pesticides/PCBs (µg/kg)								
4,4'-DDD		1.5 U	1.5 U	4.91	3.33	12.16	19.69	2.58 J
4,4'-DDE		1.5 U	1.5 U	4.08	3.01	11.04	13.05	3.69 J
4,4'-DDT		1.5 U	1.5 U	3.7	0.98	3.46	1.02	1.67 J
TOTAL DDT	46.1	2.25	2.25	12.69	7.32	26.66	33.76	7.94
PCB-8		1.5 U	1.5 U	0.88 U	0.82 U	7.04 NJ	2.5 NJ	0.21 U
PCB-18		1.5 U	1.5 U	1.49	1.23	10.81	10.89	1.16 J
PCB-28		1.5 U	1.5 U	3.68	3.82	18.93	18.86	3.45 J
PCB-44		1.5 U	1.5 U	3.35	2.74	17.16	17.67	4.13 J
PCB-52		1.5 U	1.5 U	3.15	2.56	22.02	23.21	5.12 J
PCB-66		1.5 U	1.5 U	4.14	3.83	23.61	20.97	5.65 J
PCB-101		6.6	2.2	4.42	2.77	31.94	24.13	8.04 J
PCB-105		2.1	1.5 U	2.87	2.63	9.78	8.64	4.61 J
PCB-118		1.5 U	1.5 U	4.83	3.41	21.94	18.68	5.21 J
PCB-128		1.5 U	1.5 U	0.53 U	0.50 U	8.81	5.09	1.81 J
PCB-138		2.3	1.5 U	4.67	3.45	23.54	18	5.19 J
PCB-153		3.5	1.5 U	6.02	4.28	28.01	22.4	6.13 J
PCB-170		1.6	1.5 U	1.87	1.33	5.46	3.43	1.07 J
PCB-180		1.5 U	1.5 U	3.28	2.67	11.02	7.87	2.07 J
PCB-187		1.5 U	1.5 U	2.16	1.66	8.07	5.17	1.86 J
PCB-195		1.5 U	1.5 U	1.61	1.3	NA	NA	NA
PCB-206		1.5 U	1.5 U	2.04	2.11	4.33	3.87	0.87 J
PCB-209		6	5	3.13	3.16	4.02	3.78	1.5 J
TOTAL PCB CONGENERS	180	62.2	38.4	106.83	87.22	512.98	430.32	115.95
ALPHA-CHLORDANE	6	1.5 U	1.5 U	1.2	0.54 J	4.45	2.5	0.71 J
Inorganics (mg/kg)								
ARSENIC	70	12	13	14.4	14.6	12.9	10.3	13.1
CADMIUM	9.6	0.5	0.42	0.413	0.436	1.88	1.84	0.563
CHROMIUM	370	61	58	94.7 B	93.5 B	123	111	89.6
COPPER	270	120	79	84	74	180	142	136 J
LEAD	218	110	86	94	88	165 J	147 J	123 J
NICKEL	51.6	25	22	28.6	30.4	56.0 J	35.60 J	28.95
SELENIUM	1.4	NA	NA	0.827	0.868	0.885	0.794	0.722
ZINC	410	220	160	167 B	149 B	405 J	281 J	261

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-4

OUTER PIER 1 COMPREHENSIVE SEDIMENT ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 2 OF 3

PARAMETER	ERM	OUTER PIER 1 P4R 0 - 1.0 ft DAD-23-D 20041012	OUTER PIER 1 P5 0 - 1.0 ft DAD-25 20041012	OUTER PIER 1 P6 0 - 1.0 ft DAD-26 20041012	OUTER PIER 1 TRP1-SD-003 0 - 1.0 ft TRP1-SD-003B-0001 20081107	OUTER PIER 1 TRP1-SD-003 2.0 - 4.0 ft TRP1-SD-003A-0204 20081107	OUTER PIER 1 TRP1-SD-004 0 - 1.0 ft TRP1-SD-004B-0001 20081107	OUTER PIER 1 TRP1-SD-004 2.0 - 4.0 ft TRP1-SD-004A-0204 20081107
Low Molecular Weight PAHs (µg/kg)								
2-METHYLNAPHTHALENE		51.96	46.47	29.22 J	23	24	15	53
ACENAPHTHENE		49.76	45.12	66.65	32	20	100	790
ACENAPHTHYLENE		232.75	96	161.48 J	220	120	180	150
ANTHRACENE		1143.91 J	561.83	788.56 J	430	150	390	480
FLUORENE		126.51	122.98	148.73	78	45	85	690
NAPHTHALENE		65.35	77.62	40.42 J	36	31	24	55
PHENANTHRENE		953.66 J	1218.22	1929.12	450	210	420	1700
LOW MOLECULAR WEIGHT PAHS	3160	2623.9	2168.24	3164.18	1269	600	1214	3918
High Molecular Weight PAHs (µg/kg)								
BENZO(A)ANTHRACENE		2888.87 J	2004.52	3292.41 J	1000	350	1700	1100
BENZO(A)PYRENE		2665.4 J	1243.82	1954.41 J	1300	390	1100	620
CHRYSENE		4166.44 J	2080.32	3797.91	1500	430	1700	1200
DIBENZO(A,H)ANTHRACENE		363.71	160.14	220.56 J	170	68	130	110
FLUORANTHENE		5039.17 J	4301.28	7992.24	1700	600	3100	3400
PYRENE		3848.12 J	3961.3	6207.26 J	2600	1400	3600	3200
HIGH MOLECULAR WEIGHT PAHS	9600	18971.71	13751.38	23464.79	8270	3238	11330	9630
Pesticides/PCBs (µg/kg)								
4,4'-DDD		2.83	7.96	1.49 J	4.5 U	3.8 J	1.8 U	14 UJ
4,4'-DDE		4.41	4.14	3.02 J	4.5 U	3.8 J	3.6 J	14 UJ
4,4'-DDT		2.78	2.22	0.14 U	7.2 R	5.8 R	2.8 R	18 J
TOTAL DDT	46.1	10.02	14.32	4.58	4.5	7.6	4.5	32
PCB-8		0.58 U	0.67 NJ	0.19 U	2.7 J	1.5 U	2.6 U	3.7 R
PCB-18		1.14	1.62	0.14 U	5.6 J	1.5 U	2.6 U	7.4 J
PCB-28		3.22	2.83	2.7 J	16 J	1.7 J	2.6 UJ	13 J
PCB-44		3.64	5.21	3.21 J	9.9	1.7	2.6 U	9.1 J
PCB-52		2.88	9.29	3.11 J	15 J	4.9	2.6 UJ	19 J
PCB-66		5.71	4.46	3.34 J	9.2 J	1.5 U	2.6 U	9.3 R
PCB-101		5.29	16.02	3.96 J	16	5.6	2.6 U	28
PCB-105		1.44	3.85	1.43 J	4.1 J	2.1 J	2.6 U	8.2 J
PCB-118		3.51	9.75	2.78 J	9.9 J	3.8 J	8.3 J	16 J
PCB-128		2.01	2.87	2.02 J	2.2 U	1.5 U	2.6 U	2.3 R
PCB-138		3.78	10.37	3.02 J	12 J	5.2 J	2.6 U	20 J
PCB-153		4.75	13.27	3.75 J	12	5.2 J	2.6 U	21 J
PCB-170		1.09	1.8	1.14 J	3.7 R	5 J	2.6 U	5.6 R
PCB-180		1.94	3.72	1.8 J	3 J	3.5 J	2.6 U	14 J
PCB-187		2.37	2.39	2.42 J	2.2 U	1.5 U	2.6 UJ	3.6 J
PCB-195		NA	NA	NA	2.2 U	1.5 U	2.6 U	2 U
PCB-206		0.85	1.74	0.54 J	3.8 R	5.8 J	2.6 UJ	6.2 J
PCB-209		2.18	2.37	1.17 J	5.6 J	6.7 J	2.6 UJ	2 U
TOTAL PCB CONGENERS	180	92.18	184.46	73.11	248.6	111.4	60.8	335
ALPHA-CHLORDANE	6	0.83	1.11	0.96 J	2.3 U	0.54 U	0.91 U	7 U
Inorganics (mg/kg)								
ARSENIC	70	14.8	15.3	14.1	15.00 J	5.10 J	13.80 J	12
CADMIUM	9.6	0.532	0.41	0.439	0.650 J	0.730 J	0.650 J	2.30 J
CHROMIUM	370	84.6	88.6	76.7	62.2 J	61.7 J	71.0 J	121 J
COPPER	270	82.9	76.5	95.2 J	106 J	62.1 J	130 J	203 J
LEAD	218	83.8	78.9	295 J	97.9 J	95.4 J	119 J	260 J
NICKEL	51.6	25.46	26.48	26.03	26.60 J	12.70 J	27.50 J	28.00 J
SELENIUM	1.4	0.727 J	0.805 J	0.833	4.7	2.4	6.5	5.2
ZINC	410	199	183	218	212 J	221 J	230 J	418 J

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

TABLE 4-4

OUTER PIER 1 COMPREHENSIVE SEDIMENT ANALYTICAL DATA SET
LOWER SUBASE ZONE 4 AND OUTER PIER 1 SEDIMENT CONTAMINATION DELINEATION
NSB-NLON, GROTON, CONNECTICUT
PAGE 3 OF 3

PARAMETER	ERM	OUTER PIER 1 TRP1-SD-004 4.0 - 6.0 ft TRP1-SD-004A-0406 20081107	OUTER PIER 1 TRP1-SD-005 0 - 1.0 ft TRP1-SD-005B-0001 20081107	OUTER PIER 1 TRP1-SD-005 2.0 - 4.0 ft TRP1-SD-005A-0204 20081107	OUTER PIER 1 TRP1-SD-005 4.0 - 6.0 ft TRP1-SD-005A-0406 20081107	OUTER PIER 1 TRP1-SD-006 0 - 1.0 ft TRP1-SD-006B-0001 20081107	OUTER PIER 1 TRP1-SD-006 2.0 - 3.0 ft TRP1-SD-006A-0203 20081107
Low Molecular Weight PAHs (µg/kg)							
2-METHYLNAPHTHALENE		65	19	45	270	51	140
ACENAPHTHENE		450	110	140	620	290	1500
ACENAPHTHYLENE		140	170	340	560	120	250
ANTHRACENE		620	620	1300	3000	260	1400
FLUORENE		520 J	140	300	450	180	1400
NAPHTHALENE		74	21	320	2700	120	210
PHENANTHRENE		2000	630	1400	2200	760	5700
LOW MOLECULAR WEIGHT PAHS	3160	3869	1710	3845	9800	1781	10600
High Molecular Weight PAHs (µg/kg)							
BENZO(A)ANTHRACENE		1100	1700	4700	8700	660	3100
BENZO(A)PYRENE		720	1200	2300	4400	470	1200
CHRYSENE		1200	1900	4400	8300	790	3300
DIBENZO(A,H)ANTHRACENE		97	150	280	450	76	140
FLUORANTHENE		4100	4100	16000	23000	2600	15000
PYRENE		2800	3000	11000	19000	2000	8600
HIGH MOLECULAR WEIGHT PAHS	9600	10017	12050	38680	63850	6596	31340
Pesticides/PCBs (µg/kg)							
4,4'-DDD		65 J	1.6 U	6.9 U	6.7 U	1.7 U	7.4 U
4,4'-DDE		12 U	1.6 U	6.9 U	10 J	1.2 J	7.4 U
4,4'-DDT		32 R	1.6 U	6.9 U	20	1.7 UJ	7.4 U
TOTAL DDT	46.1	71	2.4	10.35	33.35	2.9	11.1
PCB-8		3.5 J	5.9 J	9.5 J	2 U	3.9 R	2.3 U
PCB-18		1.7 U	6.9	9.5 R	2 U	31	3
PCB-28		1.7 U	2.5 U	14 J	2 UJ	23 J	4.1 R
PCB-44		1.7 U	3.9 J	9.6 J	2 U	8.7 J	2.3 U
PCB-52		3.6	2.5 U	13 J	2 UJ	9.9 J	2.3 U
PCB-66		1.7 U	2.5 U	2.1 U	2 U	4.8 R	3 R
PCB-101		2.8 R	3.3 R	8.9 J	2 U	7.6 J	4.2 R
PCB-105		3 J	2.5 U	2.1 U	2 U	2.6 J	2.3 U
PCB-118		5.2 J	5.8 J	5.8 J	4.9 J	8.3 J	5 J
PCB-128		1.7 U	2.5 U	2.1 U	2 U	2.5 U	2.3 U
PCB-138		6.2 J	3.8	6	2 U	5.3 J	5.6
PCB-153		8.1 J	3.3 J	6	2 U	6.3 J	3.6 J
PCB-170		2.6 R	2.5 U	2.1 U	2 U	3.6 J	2.3 U
PCB-180		2.7 J	2.5 U	4.9 J	2 U	2.8 J	2.3 J
PCB-187		1.7 U	2.5 U	2.1 U	2 UJ	2.5 U	2.3 U
PCB-195		1.7 U	2.5 U	2.1 U	2 U	2.5 U	2.3 U
PCB-206		12 J	2.7	2.7	2 UJ	3 J	2.3 U
PCB-209		12 J	2.5 U	2.1 U	2 UJ	2.5 U	2.3 U
TOTAL PCB CONGENERS	180	124.5	89.6	175.5	43.8	234.2	62
ALPHA-CHLORDANE	6	6.1 U	0.84 U	3.6 U	3.5 U	0.88 U	3.8 U
Inorganics (mg/kg)							
ARSENIC	70	7.9	8.3	10.2	8.7	12.90 J	12.80 J
CADMIUM	9.6	1.30 J	0.380 J	0.470 J	1.30 J	0.480 J	1.00 J
CHROMIUM	370	96.8 J	40.10 J	42.60 J	113 J	62.7 J	60.4 J
COPPER	270	207 J	64.9 J	78.7 J	201 J	80.6 J	463 J
LEAD	218	192 J	79.8 J	62.1 J	253 J	88.4 J	80.8 J
NICKEL	51.6	17.70 J	16.40 J	18.90 J	51.3 J	25.80 J	28.70 J
SELENIUM	1.4	3.7	1.8	1.5	3.5	5.90 U	4.50 U
ZINC	410	324 J	108 J	111 J	669 J	156 J	341 J

B Blank contamination
J Estimated value
NA Not analyzed
U Undetected at indicated analytical detection limit

5.0 -- Project Quality Objectives/Systematic Planning Process Statements

(UFP-QAPP Manual Section 2.6.1 – Worksheet #11)

5.1 PROBLEM STATEMENT

During the RI/FS, risks to the environment were determined to be potentially unacceptable as a result of representative ecological receptors being exposed to Zone 4 and Outer Pier 1 sediment (See Section 4.7) or ingestion of aquatic species. By reducing sediment PAH, PCB, pesticide, and metals concentrations to less than the PRGs established as part of the FS, or by preventing exposure to contaminants that exceed the PRGs, the unacceptable risks would be reduced to acceptable levels. However, remediation costs are linked to the volume and spatial distribution of contaminated sediment and the current contaminant delineation relative to established PRGs is relatively coarse. Therefore, data must be collected to more precisely delineate the known contamination to support design of a remedy that will cost-effectively reduce risks to acceptable levels. To further support the remedial design, analytic and geotechnical sediment characterization data must be collected to help determine the volume of contaminated sediment, estimate remediation costs, and develop an effective sediment dewatering approach.

5.2 DECISION INPUTS

The following data are needed to resolve the problem described in Section 5.1:

- ERM-Qs and Total PCB congener concentrations computed from measured concentrations of select PAHs, PCBs (as congeners), pesticides, and metals in Zone 4 and Outer Pier 1 sediment. Analytical methods must achieve the sensitivities obtained during the 2008 data collection effort. Sensitivity requirements are presented in Section 9. These methods must be similar to methods used previously. Suitable methods are identified in Table 8-2.

- PRGs to which the measured Zone 4 and Outer Pier 1 contaminant concentrations can be compared to achieve delineation and by which analytical methods are selected to support these comparisons. A measured concentration greater than PRG represents an unacceptable contamination level and a measured concentration less than or equal to PRG represents an acceptable contamination level. These PRG values are a Total ERM-Q = 1.17 and Total PCB congener concentration = 1 mg/kg (for PCB congeners tabulated in Tables 4-3 and 4-4).

- Sediment grain size obtained via sieve analysis, sediment bulk density, Atterberg limits, specific gravity, and organic content at a small number of locations to support engineering evaluations included in the remedial design.

- Sediment dewatering tests (gravity drainage test with geotextile fabric and pillow test for geotextile bags) at a small number of locations for assessment of sediment dewatering required for mechanical and hydraulic dredging approaches to support engineering evaluations included in the remedial design.

- Location data, obtained using a global positioning system (GPS) or more precise system to document the locations of sediment collection points. Coordinates may be measured in any units of convenience but must be documented in the North American Datum 1983 (NAD83) and North American Vertical Datum 1988 (NAVD88) systems.

- Sediment collection depths (accurate to the nearest 0.5 feet or better).

- Depth of water across Zone 4 and Outer Pier 1 and the time at which depth measurements are made (because the Zone 4 and Outer Pier 1 river level is influenced by tidal fluctuations).

- Spatial resolution requirements for delineation (see Section 5.3).

- Photographs to serve as a visual record of the field operations and site conditions.

- Lithology data (obtained in accordance with methods used during the 2008 data collection effort) to characterize the sediment lithology that will be helpful during remedial design.

Chemical and geotechnical sediment characterization data will be obtained by analyzing samples collected in accordance with procedures described in Section 8. If not identified explicitly above, methods required for data collection are identified in Section 8.

Quality control (QC) sample requirements are identified in Section 6 (field) and Section 11 (laboratory).

5.3 STUDY AREA BOUNDARIES

The population of interest for this study is Zone 4 and Outer Pier 1 sediment that have the potential to be contaminated with PAHs, PCBs, pesticides, and metals, from Zone 4 and Outer Pier 1 related operations, and sediments immediately outside the contaminated area that bound the extent of contaminated Zone 4 and Outer Pier 1 sediment. The location of this boundary is not currently known with an acceptable level of spatial precision. Previous dredging west of Zone 4 is assumed to have removed contaminated sediments as well as uncontaminated sediments from the dredged areas. The dredged area is depicted on Figure 4-6 as a yellow colored area west of the dredge buffer zone. Although sediments are not expected to be contaminated within the dredged area, a limited investigation of this previously dredged area is necessary to confirm that sediments west of the dredge buffer zone are not contaminated. If data indicate that contaminated sediments extend west of the buffer zone, investigation of those sediments will be considered in future contaminant delineation. The Quay Wall places a physical eastern bound on the possible extent of contaminated Zone 4 sediment. It was agreed during comment resolution, that samples would not be collected beneath the Quay Wall. Post-remediation monitoring will be conducted to ensure potentially-contaminated sediments behind the Quay Wall do not recontaminate the remaining Zone 4 sediments following the remedial action. The new Pier 6 places a boundary to the north. Additional sediment samples are not needed north of Pier 6 because that is the start of Zone 3 and the ecological risk assessment for the Thames River showed that risks to ecological receptors in sediment adjacent to Zone 3 are relatively low. Finally, previous sampling provides an initial estimate of the maximum extent of contaminated Zone 4 sediment to the south. Together, these data were used to establish a study area that spans much of Zone 4 sediment and extends slightly south of Pier 2. The majority of contaminated sediment at Outer Pier 1 was dredged during a previous removal action. As shown on Figure 4-7, previous sampling identified contamination at Outer Pier 1 at only one location (TRP1-SD-005) located at the southern end of the former Pier 1. Based on the existing data, the study area for Outer Pier 1 sediment is focused around sample location TRP1-SD-005.

Figure 5-1 displays two polygons (yellow lines) representing the study area boundaries for Zone 4 and Outer Pier 1, respectively. The boundaries include both the maximum area that is expected to have sediment concentrations in excess of PRGs and the area of uncontaminated sediment that is expected to bound the contaminated Zone 4 and Outer Pier 1 sediments, respectively.

Pre-2010 data and data collected for this investigation must be combined to establish concentration gradients that can be used to delineate the extent of contamination to a finer degree of resolution than currently available. This requires that data collection points for which no contaminant concentration data are available, in both the horizontal and vertical direction, be interspersed among previously investigated locations. It also requires that additional perimeter sampling locations be investigated where ERM-Qs and Total PCB concentrations exceed PRGs.

Based on previous data, contaminant concentrations are greatest in the range of 2 to 6 feet bss; therefore, the vertical extent of delineation is constrained to not exceed 10 feet bss.

5.4 ANALYTIC APPROACH

To resolve the problem statement of Section 5.1, the Project Team must estimate the spatial extent of contamination greater than PRGs. The project team will allocate data collection points to minimize the amount of sediment that would have to be dredged to reduce risks to acceptable levels.

To determine when delineation is complete, the following decision rule will be applied to both new and previously collected data:

> If the measured contaminant concentrations are less than or equal to PRGs (Total ERM-Q = 1.17 and 1 mg/kg total PCB congeners) at every perimeter data collection point (in both the horizontal and vertical direction) associated with Zone 4 and Outer Pier 1 sediment and no significant data quality deficiencies (See Sections 8 and 12) are identified, then stop delineation; otherwise recommend additional delineation.

Note that Zone 4 sediment samples from three locations (TRZ4-SD-023 to TRZ4-SD-025) collected during the sampling event will be held for analysis. Sediment samples from these locations will be analyzed only if the chemical concentrations for adjacent samples exceed a PRG (see Table 8-2 for identification of adjacent samples). In addition, Outer Pier 1 sediment samples (TRP1-SD-011 to TRP1-SD-013) collected from 0 to 1 foot and 8 to 10 feet will be held for analysis. Sediment samples from these depths will be analyzed only if the chemical concentrations in adjacent sample intervals (2 to 4 feet and 6 to 8 feet, respectively) exceed a PRG.

Data obtained from geotechnical analyses and dewatering tests will be evaluated by the Navy's Remedial Design Contractor to determine if the data is adequate to support engineering evaluations included in the remedial design.

5.5 PERFORMANCE CRITERIA

This investigation requires sampling previously unsampled locations to generate a more complete understanding of the spatial distribution of contamination as well as collecting geotechnical data to better characterize site conditions that will help the remedial design engineer estimate remediation costs and dewatering approaches. This type of work requires use of judgmental locations designed to add to the spatial coverage of the current data set. If all data from the judgmental locations are obtained and no data quality deficiencies are detected, the data will be considered complete and suitable for rendering the decision governed by the rule in Section 5.4. Data quality will be evaluated in accordance with Section 12 (verification and validation) and Section 8 (usability assessment). As the number of data quality deficiencies or missing data points increases, the tendency will be for the Project Team to recommend additional data collection.

5.6 SAMPLING DESIGN AND RATIONALE

The sampling design and rationale are described in detail in Section 7.

6.0 -- Field Quality Control Samples

(UFP-QAPP Manual Section 2.6.2 – Worksheet #12)

Quality Control (QC) Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPCs)	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Equipment Rinsate Blanks[1]	All analytical groups	One per 20 samples.	Bias/Contamination	No target analytes ≥½ limit of quantitation (LOQ), except common laboratory contaminants, which must be < LOQ.	S & A
Field Duplicates	Organics	One per 10 samples.	Precision	Soils: Relative percent difference (RPD) must be ≤ 50%. Waters: RPD must be ≤ 30%. If sample results are < 2x LOQ, professional judgment is used.	S & A
	Metals	One per 10 samples.	Precision	For values ≥ 5x LOQ Soils: RPD must be ≤ 50% Waters: RPD must be ≤ 30%. For values < 5x LOQ Soils: Absolute difference must be ≤ 4x LOQ Waters: Absolute difference must be ≤ 2x LOQ for waters.	S & A
Cooler Temperature Indicator	All analytical groups	One per cooler.	Representativeness	Temperature must be less than or equal to 6 degrees Celsius (≤ 6 ^{o}C).	S

1 Equipment rinsate blanks will be collected if non-dedicated sampling equipment is used. For disposable equipment, one sample per batch of disposable equipment will be collected

7.0 -- Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1 – Worksheet #17)

The sampling design for this project is judgmental. The sample locations and number of samples were selected to fill data gaps for delineation of contamination and the remedial design. Sediment was previously sampled during the LS RI, Pilot Study, Thames River Validation Study, and as part of the FS. Based on these previous sampling events, sediment samples will be located in and adjacent to the area exceeding ecological PRGs adjacent to Zone 4 and at Outer Pier 1 (Figure 5-1).

Medium and Analyses Rationale

This SAP covers the collection and analysis of sediment from the Thames River adjacent to NSB-NLON adjacent to Zone 4 and at Outer Pier 1. Data collected during the Thames River Validation Study and FS determined that sediment contained elevated levels of metals, PAHs, pesticides, and PCBs. Although surface water is a transport mechanism for suspended particulates, it was not found to be a medium of concern in the study areas.

SAP results will be compared to ecological PRGs. Sediment chemical analyses and sediment toxicity tests to evaluate the effects of contaminated sediment on benthic invertebrates were performed during the Validation Study. Toxicity test results were compared to chemistry results, including ERM-Q, metals ERM-Q, and total PCB concentrations. From these correlations, PRGs were identified as part of the FS. Parameters used to determine the PRGs include PAHs, metals, PCBs (congeners), and pesticides.

Select sediment samples will also be tested for grain size, bulk density, Atterberg limits, specific gravity, and organic content to characterize physical properties of the sediment. In addition, two dewatering tests will be conducted on the sediment including a gravity drainage test and a pillow test for geotextile bags, which will simulate the dewatering that would occur on mechanically dredged material and hydraulically dredged material, respectively. Analysis of geotechnical engineering parameters and dewatering tests will be performed on the two major types of sediment (cohesive and noncohesive) present in the area. Sediment that is mostly clay is considered cohesive, while sediment that is mostly silt, sand, and gravel is noncohesive.

Although all sediment samples will be collected during the same sampling event, sediment samples from three locations adjacent to Zone 4 (TRZ4-SD-023 to TRZ4-SD-025) will be held for analysis. Sediment samples from these locations will be analyzed only if the chemical concentrations for adjacent samples exceed a PRG (see Table 8-2 for identification of adjacent samples). Sediment samples from three locations in Outer Pier 1 (TRP1-SD-011 to TRP1-SD-013) collected at 0 to 1 foot and 8 to 10 feet will be held for analysis. Sediment samples from these depths will be analyzed only if the chemical concentrations in adjacent sample intervals (2 to 4 feet and 6 to 8 feet, respectively) exceed a PRG. Because the hold time for the organic chemicals is 14 days, the samples from TRZ4-SD-023 to TRZ4-SD-025 and TRP1-SD-11 to TRP1-SD-13 for PAH and pesticide analyses will be frozen until the results from adjacent samples are available and reviewed. Because the hold time for PCBs and metals are one year and 6 months, respectively, the samples from TRZ4-SD-023 to TRZ4-SD-025 and TRP1-SD-11 to TRP1-SD-13 for these chemicals will be refrigerated until the results from adjacent samples are available and reviewed. Samples adjacent to Zone 4 samples being held for analysis and Outer Pier 1 samples from 2 to 4 feet and 6 to 8 feet intervals will be analyzed within an expedited 10-day timeframe so that prompt determinations can be made whether or not the samples on hold should be analyzed.

Zone 4 Sample Location Rationale

A quay wall exists along the length of the Zone 4 waterfront. Previous sediment sample locations collected in Zone 4 are presented on Figure 4-6. Figure 4-6 also shows samples with concentrations exceeding ecological PRGs at Zone 4. The depth and lateral extent of contamination in Zone 4 sediment is not fully established. Sediment sampling locations were selected to delineate the extent of contamination to support design of a remedy that will reduce risks to acceptable levels.

Some of the sediment more than 100 feet from the Zone 4 quay wall was removed during maintenance dredging, as shown on Figure 4-6. To confirm that sediments west of the dredge buffer zone are not contaminated, a few sediment samples will be collected within the former Maintenance Dredging Area.

Details of field activities and laboratory analyses, including samples to be collected and the analyses to be conducted on each sample, are provided in Section 8 and associated tables.

Outer Pier 1 Sample Location Rationale

A portion of Outer Pier 1 sediment was dredged during a removal action. Previous sediment sample locations collected from Outer Pier 1, excluding those samples from within the dredged area, are presented on Figure 4-7. Figure 4-7 shows the only sample, TRP1-SD-005, that had concentrations exceeding ecological PRGs at Outer Pier 1. The depth and lateral extent of contamination in Outer Pier 1 sediment around this sample location is not fully established. Sediment sampling locations were selected to delineate the extent of contamination in the vicinity of TRP1-SD-005 to support design of a remedy that will reduce risks to acceptable levels.

Details of field activities and laboratory analyses, including samples to be collected and the analyses to be conducted on each sample, are provided in Section 8 and associated tables.

Dewatering Tests and Geotechnical Engineering Parameters Sample Location Rationale

To adequately design the dewatering system required as a component of the remedy information is needed on the behavior of the sediments in simulated dewatering tests. Mechanical dredging would occur at locations away from structures as a clamshell or environmental bucket is not able to be maneuvered close to structures. Hydraulic dredging would occur near structures where mechanical dredging is not practical.

Sampling for the dewatering tests will occur at four locations with a single sediment material type (cohesive or noncohesive) collected at each location. The exact sampling locations will be determined in the field as the locations are dependent on the type of sediment material (cohesive or noncohesive) present. The two sediment samples (one cohesive and one noncohesive) for the gravity drainage test that will be used to evaluate dewatering from mechanical dredging will be collected from the approximate center of the Zone 4 sediment investigation area (e.g., near TRZ4-SD-026). The two sediment samples (one cohesive and one noncohesive) for the pillow test for geotextile bags that will be used to evaluate dewatering from hydraulic dredging will be collected near the Quay wall (e.g., near TRZ4-SD-022).

One sample for analysis of geotechnical engineering parameters will be collected at each of the four locations chosen for the dewatering tests. Additional samples for geotechnical analysis will be collected from two additional locations determined in the field from across the sampling area with a single sediment material type (cohesive or noncohesive) collected at each location.

Details of field activities and laboratory analyses, including samples to be collected and the analyses to be conducted on each sample, are provided in Section 8 and associated tables.

8.0 -- Field Project Implementation

(UFP-QAPP Manual Section 5.2.3)

8.1 Field Project Tasks

(UFP-QAPP Manual Section 2.8.1 – Worksheet #14)

The field project tasks include:

- Mobilization/Demobilization
- Vibracore Sediment Sampling
- Dewatering Tests Sampling
- Geotechnical Engineering Parameters Sampling
- Bulk Density Sampling
- QC Tasks
- Equipment Decontamination
- Investigation-Derived Waste Management

The standard operating procedures (SOPs) and field documents referenced below are included in Appendices A and B.

Mobilization/Demobilization

A field team orientation meeting will be conducted prior to the start of fieldwork to familiarize the team personnel with the site's health and safety requirements, objectives and scope of the field activities, and chain-of-command. This meeting will be attended by the FOL/SSO, PM, and lead chemist. Mobilization activities will include transporting field personnel, equipment, supplies, and the boat subcontractor (TG&B Marine Services) to the site. One mobilization is planned for Spring 2012. All coring equipment and sampling tools will be cleaned prior to arrival on site. A 1-hour health and safety meeting will be conducted prior to initiating onsite activities. All subcontractor personnel (including substitutes) will attend the meeting. Tetra Tech will coordinate with the Navy POC at NSB-NLON regarding passes, security and access issues, Navy-required training, and daily activities. Tetra Tech will also coordinate with the Navy RPM and stakeholders regarding the field activities. Demobilization will include transporting personnel, field equipment, supplies, and TG&B Marine Services from the site, performing general site cleanup, and organizing and finalizing field paperwork.

Vibracore Sediment Sampling

The Tetra Tech FOL/SSO and TG&B Marine Services (captain and one crew member) will perform the vibracore sediment sampling task. TG&B Marine Services will launch their boat at the boat launch near former Pier 1 or a nearby public launch facility and navigate to the study area. The Navy POC at NSB-NLON will pre-arrange site access with the Port Operations and Security Departments at NSB-NLON. The boat captain will also be required to contact Port Operations prior to and at the end of sampling. Upon approach to NSB-NLON, the boat captain will radio the Port Operations and Security Departments regarding access and their daily plans. After gaining access to the site, the boat will be navigated by the captain to the sampling locations using pre-determined coordinates and a differential GPS. The coordinates for each sample location are provided in Table 8-1.

Upon arrival at a sample location, the boat will be anchored to remain over the desired location, and one 6-foot-long sediment core or one 10-foot-long sediment core will be collected using the vibracore method. A 3-inch-diameter stainless steel core barrel with a cutting edge and retaining fingers at the lower end will be used to collect the cores. A 2⅝-inch polycarbonate tube will be included inside of the core barrel to contain the sample after collection. Core samples will be collected at 18 locations at Zone 4 and at 3 locations at Outer Pier 1 (Figure 5-1). After retrieval of the cores to the surface, the core tubes will be removed from the core barrel and secured. Excess water at the top of the core will be drained. The core tubes will be transported onshore and opened at a designated work station. After opening, each sediment core will be photographed and thoroughly described on a boring log by a Tetra Tech geologist. Samples will be collected from intervals between 0 to 6 feet bss (0 to 1 foot bss, 2 to 4 feet bss, and 4 to 6 feet bss), 4 to 10 feet bss (4 to 6 feet bss, 6 to 8 feet bss, and 8 to 10 feet bss) or 0 to 10 feet bss (0 to 1 foot bss, 2 to 4 feet bss, 4 to 6 feet bss, 6 to 8 feet bss, and 9 to 10 feet bss) as identified in Table 8-1 and on Figure 5-1. Sediment cores will be 6-foot-long or 10-foot-long, depending upon the intervals collected. The volume of sediment required per interval sampled to complete the required chemical analyses is identified in Table 8-2. Sample material will be homogenized in disposable bowls with disposable trowels. After homogenization, disposable trowels will be used to place the sediment in the appropriate sample bottles. The bottles will be secured after filling and then placed on ice in coolers. The coolers will be secured for shipment to the laboratory. Additional information regarding sediment sampling procedures is provided in the Tetra Tech SOPs SA-1.2 and SA-6.1 listed in Section 8.3 and included in Appendix A.

Dewatering Tests Sampling

Additional core samples will be collected from several locations to provide composite samples for gravity drainage tests and pillow tests for geotextile bags. The sampling locations and depths will be determined in the field based upon the location of cohesive and noncohesive material as discussed in Section 7. Up to 10-foot-long sediment core samples will be collected using the vibracore method. A 3-3/4 inch core sampler or similar sampler will be used to collect the cores. Based on a visual examination of the core, cohesive material will segregated and placed into 5 gallon buckets. Several core samples will be collected until sufficient volume of cohesive material is collected to obtain one composite sample for the gravity drainage test (5 gallons) and one composite sample for the pillow test (10 gallons). Each composite sample may be comprised of several depth intervals and several locations. Each sampling location and depth will be recorded. The same process will be repeated for noncohesive material. The sediment will be placed in air tight containers and will be secured for shipment to the laboratory.

Geotechnical Engineering Parameters Sampling

The geotechnical engineering parameters will be collected from across the area to be sampled with four samples collected at the locations for the dewatering tests samples and two samples collected from locations selected for chemical analysis. The sampling locations and depths will be determined in the field based upon the location of cohesive and noncohesive material. Three samples of cohesive material and three samples of noncohesive material will be collected. Each sample will consist of a single depth interval at one location. Each sampling location and depth will be recorded. The volume of sediment required per interval sampled to complete the required geotechnical analyses is identified in Table 8-2. Sample material will be homogenized in disposable bowls with disposable trowels. After homogenization, disposable trowels will be used to place the sediment in the appropriate sample bottles. The bottles will be secured after filling and then placed on ice in coolers. The coolers will be secured for shipment to the laboratory.

Bulk Density Sampling

An additional core sample will be collected at the locations determined in the field for analysis of geotechnical engineering parameters. The sediment core will be collected using the vibracore method. The polycarbonate tube containing the core will be cut into one-foot-long sections to provide undisturbed sediment for bulk density analysis with only one section from the depth sampled for other geotechnical parameters selected for analysis. The ends of the section of polycarbonate tube will be capped and sealed (waxed and taped) to secure the sediment in place inside the tube. The tube will then be placed on ice in a cooler and the cooler will be secured for shipment to the laboratory.

QC Tasks

Equipment rinsate blanks, field duplicates, and temperature blanks will be collected at the frequency listed in Section 6 and the total numbers presented in Table 8-3. Also, additional sample volume will be collected for the laboratory to perform matrix spike/matrix spike duplicate (MS/MSD) analysis.

Equipment Decontamination

The decontamination procedures presented in Tetra Tech SOP SA-7.1 listed in Section 8.3 and included in Appendix A will be followed for this project. The core barrel and cutting head will be decontaminated between uses at the sample locations. The core barrel will be scrubbed cleaned of all visible debris, sprayed down with a soap and water solution, and rinsed in river water. The dilute decontamination fluids will be discharged to the Thames River. To minimize decontamination, new disposal trowels and bowls will be used to process each sediment sample and will be discarded after one use. Therefore, decontamination of this equipment will not be necessary. Personal protective equipment and emergency decontamination procedures are discussed in the Health and Safety Plan (HASP).

Investigation-Derived Waste Management

Disposable core liners, used personal protective equipment, and general project refuse will be collected and placed in plastic bags (doubly-lined) and disposed in a Navy-approved trash receptacle. Waste water generated during decontamination of vibracore sampling equipment will be discharged into the Thames River. Any residual sediment left over after sampling will also be returned to the Thames River.

8.2 Additional Project-Related Tasks

The additional project-related tasks include:

- Analytical Tasks
- Data Management
- Data Review
- Project Reports

Analytical Tasks

Chemical analysis of the sediment samples for PAHs, pesticides, total metals, and PCBs (congeners) will be performed by a subcontracted laboratory, Mitkem (Warwick, RI). Testing for geotechnical engineering parameters (grain size, bulk density, Atterberg limits, specific gravity, and organic content) and dewatering tests will be performed by Geotesting Express (Acton, MA), a subcontractor to Mitkem. Mitkem is a Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP)-accredited laboratory. A copy of Mitkem's accreditation is included in Appendix C. Analyses will be performed in accordance with the analytical methods identified in Table 8-2 and the requirements of the technical specification for laboratory services developed by Tetra Tech for this work. Mitkem will meet the

PALs specified in Section 9 and will perform the chemical analyses following laboratory-specific SOPs (see Table 8-2 and Section 10) developed based on the methods listed in Table 8-2. Laboratory SOPs are not included in this SAP but have been reviewed to ensure they are suitable for use on this project.

All sediment results will be reported by the laboratory on an adjusted dry-weight basis. Results of percent moisture will be reported in each analytical data package and associated electronic data files. This information will also be captured in the project database, which will eventually be uploaded to the Naval Installation Restoration Information Solution (NIRIS) database. Percent moisture information will also be captured in the site investigation report.

The analytical data packages provided by Mitkem will be in a CLP-SOW-like format and will be fully validatable and contain raw data, summary forms for all sample and laboratory method blank data, and summary forms containing all method-specific QC (results, recoveries, RPDs, relative standard deviations (RSD), and/or percent differences, etc.).

Data Management

The principal data generated for this project will be from field data and laboratory analytical data. Field sampling log sheets will be organized by date and medium, and filed in the project files and included in the project completion report. The field logbooks for this project will be used only for this site and will also be categorized and maintained in the project files after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be titled based on date and activity.

The data handling procedures to be followed by Mitkem will meet the requirements of the technical specifications. Electronic data results will be automatically downloaded into the Tetra Tech database in accordance with the proprietary Tetra Tech processes.

The Tetra Tech PM (or designee) is responsible for the overall tracking and control of data generated for the project.

- **Data Tracking**. Data are tracked from generation to archiving in the Tetra Tech project-specific files. The Tetra Tech Project Chemist (or designee) is responsible for tracking the samples collected and shipped to Mitkem. Upon receipt of the data packages from Mitkem, the Tetra Tech Project Chemist will monitor the data validation effort, which includes verifying that the data packages are complete and results for all samples have been delivered by Mitkem.

- **Data Storage, Archiving, and Retrieval**. The data packages received from Mitkem are tracked in the data validation logbook. After the data are validated, the data packages are entered into the Tetra Tech Comprehensive Long-Term Environmental Action Navy (CLEAN) file system and archived in secure files. The field records including field log books, sample logs, chain-of-custody records, and field calibration logs will be submitted by the Tetra Tech FOL to be entered into the Navy CLEAN file system prior to archiving in secure project files. Project files are audited for accuracy and completeness. At the completion of the Navy contract, the records will be stored by Tetra Tech.

- **Data Security**. Access to Tetra Tech project files is restricted to designated personnel only. Records can only be borrowed temporarily from the project file using a sign-out system. The Tetra Tech Data Manager maintains the electronic data files, and access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

- **Electronic Data**. All electronic data will be compiled into a NIRIS Electronic Data Deliverable (NEDD) and loaded into NIRIS.

Data Review

This review comprises data verification, validation, and usability assessment. The data verification and validation processes and requirements are described in Section 12. The data usability assessment will, at a minimum, constitute evaluation of the following characteristics to ensure that the amount, type, and quality of data are sufficient to achieve project objectives. The means of conducting these evaluations will vary, depending on the nature of the data. For example, sample boring logs will generally be evaluated qualitatively or semi-quantitatively, whereas precision, accuracy, and sensitivity of analytical data will generally be evaluated quantitatively and may be based on, or may supplement, data validation findings. Examples include:

- Comparing actual to intended sampling locations and verifying that the correct datum was used to delineate contamination
- Evaluating trends across sample delivery groups (SDGs) or sampling events
- Identifying potential errant or outlier data points
- Assessing planning assumption validity
- Evaluating the potential for contamination of samples by samplers

Data quality indicators to be evaluated during this assessment include:

1. **Precision.** A semi-quantitative estimate of the uncertainty in contaminant concentrations as a function of location will be made.

2. **Accuracy.** Accuracy data will be evaluated to ensure sampling and measurement accuracy is within or exceeds analytical method specifications and may depend in part on the data validation findings.

3. **Representativeness.** This evaluation will assess whether the data are adequately representative of intended populations based on the sample collection and data generation requirements specified in this SAP.

4. **Completeness.** Failure to obtain critical data from planned locations will be documented. Minor variations in actual versus intended sampling locations (or depths) that do not adversely affect the attainment of project objectives will not be documented.

5. **Comparability.** This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction for each sampled area. This will not require quantitative comparisons unless the Tetra Tech Project Chemist indicates that such quantitative analysis is beneficial to the project and the Tetra Tech PM agrees.

6. **Sensitivity.** The Tetra Tech Project Chemist will determine whether project sensitivity goals were achieved by comparing non-detect values to project action limits (PALs).

7. **Other quantitative characteristics.** These may include quantities such as verification of sediment volume calculations that are used to determine whether the contaminants are sufficiently well delineated to estimate remediation costs.

If significant data quality deficiencies are detected that prevent the attainment of project objectives, the limitations on the affected data will be described in the project report. The Tetra Tech PM will bring these deficiencies to the attention of the project team for their evaluation and the team will determine an appropriate corrective action depending on the circumstances.

- **Project Report** - The analytical data generated under this SAP will be used to support design of a remedy that will cost-effectively reduce contaminant concentrations to less than PRGs and thus reduce risks to acceptable levels.

Draft versions of these documents will be prepared and submitted in hardcopy format to the Navy, USEPA, CTDEEP, and NOAA for review and comment. Tetra Tech will develop responses to comments received on the draft reports. The final versions of the reports will be submitted in hardcopy and electronic format to the project team.

8.3 Field SOPs Reference Table

(UFP-QAPP Manual Section 3.1.2 – Worksheet #21)

Reference Number	Title, Revision Date, and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
CT-04	Sample Nomenclature	Tetra Tech	NA	Y	Contained in Appendix A
SA-6.3	Field Documentation	Tetra Tech	Field Logbook, Field Sample Forms, Boring Logs	Y	Contained in Appendix A
SA-6.1	Non-Radiological Sample Handling	Tetra Tech	Sample Bottleware, Packaging Material, Shipping Materials	Y	Contained in Appendix A
SA-1.2	Surface Water and Sediment Sampling	Tetra Tech	Sampling Procedures, Methods	Y	Contained in Appendix A
SA-7.1	Decontamination of Field Equipment	Tetra Tech	Decontaminate core barrel and cutting head (scrub brushes, phosphate-free detergent, river water rinse)	Y	Contained in Appendix A
NA	Vibracoring Procedure	TG&B Marine Services	Vibracore sampling equipment (BH-5 pneumatically driven system, air compressor, core barrel, cutting head)	N	Contained in Appendix A

Table 8-1 – Sample Details Table

(UFP-QAPP Manual Section 3.1.1 and 3.5.2.3 – Worksheet #18, 19, 20 and 30)

Sample Location	Northing (NAD83)	Easting (NAD83)	Depths (feet bss)	Sample IDs	Analytical Group	Analysis Details
Zone 4						
TRZ4-SD-009	703958.291	1180993.281	4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-009-0406 TRZ4-SD-009-0608 TRZ4-SD-009-0810	PAHs, PCBs, pesticides, metals	None.
TRZ4-SD-010	703868.375	1180980.384	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-010-0001 TRZ4-SD-010-0204 TRZ4-SD-010-0406 TRZ4-SD-010-0608 TRZ4-SD-010-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis(1); results used to determine analysis of TRZ4-SD-023.
TRZ4-SD-011	703819.429	1180955.089	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-011-0001 TRZ4-SD-011-0204 TRZ4-SD-011-0406 TRZ4-SD-011-0608 TRZ4-SD-011-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis(1); results used to determine analysis of TRZ4-SD-023.
TRZ4-SD-012	703952.005	1180873.864	0 to 1 foot, 2 to 4 feet, 4 to 6 feet	TRZ4-SD-012-0001 TRZ4-SD-012-0204 TRZ4-SD-012-0406	PAHs, PCBs, pesticides, metals	None.
TRZ4-SD-013	703868.201	1180801.587	0 to 1 foot, 2 to 4 feet, 4 to 6 feet	TRZ4-SD-013-0001 TRZ4-SD-013-0204 TRZ4-SD-013-0406	PAHs, PCBs, pesticides, metals	Quick turn analysis(1); results used to determine analysis of TRZ4-SD-024.
TRZ4-SD-014	704020.093	1180731.402	0 to 1 foot, 2 to 4 feet, 4 to 6 feet	TRZ4-SD-014-0001 TRZ4-SD-014-0204 TRZ4-SD-014-0406	PAHs, PCBs, pesticides, metals	None.
TRZ4-SD-015	704105.991	1180708.355	0 to 1 foot, 2 to 4 feet, 4 to 6 feet	TRZ4-SD-015-0001 TRZ4-SD-015-0204 TRZ4-SD-015-0406	PAHs, PCBs, pesticides, metals	None.

Sample Location	Northing (NAD83)	Easting (NAD83)	Depths (feet bss)	Sample IDs	Analytical Group	Analysis Details
TRZ4-SD-016	704198.174	1180759.682	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-016-0001 TRZ4-SD-016-0204 TRZ4-SD-016-0406 TRZ4-SD-016-0608 TRZ4-SD-016-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis(1); results used to determine analysis of TRZ4-SD-025.
TRZ4-SD-017	704256.837	1180815.2	4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-017-0406 TRZ4-SD-017-0608 TRZ4-SD-017-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis(1); results used to determine analysis of TRZ4-SD-025.
TRZ4-SD-018	704314.451	1180765.966	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-018-0001 TRZ4-SD-018-0204 TRZ4-SD-018-0406 TRZ4-SD-018-0608 TRZ4-SD-018-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis(1); results used to determine analysis of TRZ4-SD-025.
TRZ4-SD-019	704380.445	1180745.015	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-019-0001 TRZ4-SD-019-0204 TRZ4-SD-019-0406 TRZ4-SD-019-0608 TRZ4-SD-019-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis(1); results used to determine analysis of TRZ4-SD-025.
TRZ4-SD-020	704320.737	1180824.626	4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-020-0406 TRZ4-SD-020-0608 TRZ4-SD-020-0810	PAHs, PCBs, pesticides, metals	None.
TRZ4-SD-021	704140.562	1180931.475	4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-021-0406 TRZ4-SD-021-0608 TRZ4-SD-021-0810	PAHs, PCBs, pesticides, metals	None.
TRZ4-SD-022	704034.761	1180957.664	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-022-0001 TRZ4-SD-022-0204 TRZ4-SD-022-0406 TRZ4-SD-022-0608 TRZ4-SD-022-0810	PAHs, PCBs, pesticides, metals, grain size, bulk density	None.

Sample Location	Northing (NAD83)	Easting (NAD83)	Depths (feet bss)	Sample IDs	Analytical Group	Analysis Details
TRZ4-SD-023	703776.782	1181010.953	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-023-0001 TRZ4-SD-023-0204 TRZ4-SD-023-0406 TRZ4-SD-023-0608 TRZ4-SD-023-0810	PAHs, PCBs, pesticides, metals	Hold for analysis.(2)
TRZ4-SD-024	703770.528	1180767.656	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-024-0001 TRZ4-SD-024-0204 TRZ4-SD-024-0406 TRZ4-SD-024-0608 TRZ4-SD-024-0810	PAHs, PCBs, pesticides, metals	Hold for analysis.(2)
TRZ4-SD-025	704308.191	1180693.67	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-025-0001 TRZ4-SD-025-0204 TRZ4-SD-025-0406 TRZ4-SD-025-0608 TRZ4-SD-025-0810	PAHs, PCBs, pesticides, metals	Hold for analysis.(2)
TRZ4-SD-026	704120.114	1180867.679	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRZ4-SD-026-0001 TRZ4-SD-026-0204 TRZ4-SD-026-0406 TRZ4-SD-026-0608 TRZ4-SD-026-0810	PAHs, PCBs, pesticides, metals	None.
TRZ4-SD-C001 (cohesive material near center of sampling area)	TBD(3)	TBD(3)	TBD(3)	TRZ4-SD-C1G1-XXXX TRZ4-SD-C1G2-XXXX TRZ4-SD-C1GX-XXXX	Gravity Drainage Test	None.
TRZ4-SD-C002 (noncohesive material near center of sampling area)	TBD(3)	TBD(3)	TBD(3)	TRZ4-SD-C2G1-XXXX TRZ4-SD-C2G2-XXXX TRZ4-SD-C2GX-XXXX	Gravity Drainage Test	None.
TRZ4-SD-C003 (cohesive material near Quay wall)	TBD(3)	TBD(3)	TBD(3)	TRZ4-SD-C3G1-XXXX TRZ4-SD-C3G2-XXXX TRZ4-SD-C3GX-XXXX	Pillow Test for Geotextile Bags	None.
TRZ4-SD-C004 (noncohesive material near Quay wall)	TBD(3)	TBD(3)	TBD(3)	TRZ4-SD-C4G1-XXXX TRZ4-SD-C4G2-XXXX TRZ4-SD-C4GX-XXXX	Pillow Test for Geotextile Bags	None.

Sample Location	Northing (NAD83)	Easting (NAD83)	Depths (feet bss)	Sample IDs	Analytical Group	Analysis Details
Outer Pier 1						
TRP1-SD-011	703321.009	1181083.863	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRP1-SD-011-0001 TRP1-SD-011-0204 TRP1-SD-011-0406 TRP1-SD-011-0608 TRP1-SD-011-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis for 2 to 4 feet and 6 to 8 feet intervals. Hold 0 to 1 foot and 8 to 10 feet intervals.(4)
TRP1-SD-012	703393	1181152.063	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRP1-SD-012-0001 TRP1-SD-012-0204 TRP1-SD-012-0406 TRP1-SD-012-0608 TRP1-SD-012-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis for 2 to 4 feet and 6 to 8 feet intervals. Hold 0 to 1 foot and 8 to 10 feet intervals.(4)
TRP1-SD-013	703329.289	1181167.807	0 to 1 foot, 2 to 4 feet, 4 to 6 feet, 6 to 8 feet, 8 to 10 feet	TRP1-SD-013-0001 TRP1-SD-013-0204 TRP1-SD-013-0406 TRP1-SD-013-0608 TRP1-SD-013-0810	PAHs, PCBs, pesticides, metals	Quick turn analysis for 2 to 4 feet and 6 to 8 feet intervals. Hold 0 to 1 foot and 8 to 10 feet intervals.(4)

Notes:
Six samples will be analyzed for geotechnical engineering parameters (i.e., grain size, bulk density, Atterberg limits, specific gravity, and organic content). These samples will be collected from the four locations for the dewatering tests (gravity drainage test and pillow test for geotextile bags) and two other locations from the sampling area.

Footnotes:
1 Samples for quick-turn (10 day) analysis.
2 Samples will be held for analysis until results from adjacent samples are reviewed and a decision is made as to whether the samples need to be analyzed.
3 Sampling location will be determined in the field based on location with sufficient volume (5 gallons for gravity drainage test and 10 gallons for pillow test) of cohesive and noncohesive material. The coordinates, depths, and sample ID will be determined and recorded in the field for each grab sample used to obtain a composite sample.
4 Samples from 0 to 1 foot and 8 to 10 feet will be held for analysis until results from adjacent sample intervals (2 to 4 feet and 6 to 8 feet) are reviewed and a decision is made as to whether the samples need to be analyzed.

Table 8-2 - Analytical SOP Requirements Table

Laboratory point of contact, e-mail address, and phone number: Edward Lawler, elawler@mitkem.com, 401-732-3400

Laboratory Name and Address:
Mitkem Laboratories
175 Metro Center Boulevard
Warwick, RI 02886-1755
Data Package Turnaround time: 21 days
Tentative Sampling Dates: TBD

Matrix	Analytical Group	Preparation Method/ Analytical Method/ SOP Reference (1)	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous Field QC	PAHs	SW-846 3510C, 3520C/8270D/ Lab SOPs 1, 13, 14, 9	1 Liter (L) amber glass bottle	1 L	Cool to 6^{o}C	7 days to extraction; 40 days to analysis
	PCB Congeners	SW-846 3510C, 3520C/8082A/ Lab SOPs 3, 13, 14, 9	1 L amber glass bottle	1 L	Cool to 6^{o}C	7 days to extraction; 40 days to analysis
	Select Pesticides	SW-846 3510C, 3520C/8081A/ Lab SOPs 2, 13, 14, 9	1 L amber glass bottle	1 L	Cool to 6^{o}C	7 days to extraction; 40 days to analysis
	Select Metals	SW-846 3050B/6010C / Lab SOPs 4, 15	250 milliliter (mL) high-density polyethylene plastic bottle	100 mL	Nitric acid to pH <2, Cool to 6^{o}C	180 days to analysis [Inductively Coupled Plasma (ICP) metals]
Sediment	PAHs	SW-846 3540C, 3550B, or 3570/8270D/ Lab SOPs 1, 6, 7, 8, 9	8 ounce (oz) wide-mouth jar	30 grams (g)	Cool to 6^{o}C	14 days to extraction; 40 days to analysis
					Cool to -20^{o}C	8 weeks to extraction; 40 days from extraction to analysis
	PCB Congeners	SW-846 3540C, 3550B, or 3570/8082A/ Lab SOPs 3, 6, 7, 8, 9		30 g	Cool to 6^{o}C	14 days to extraction; 40 days to analysis
	Select Pesticides	SW-846 3540C, 3550B, or 3570/8081A/ Lab SOPs 2, 6, 7, 8, 9		30 g	Cool to 6^{o}C	14 days to extraction; 40 days to analysis
					Cool to -20^{o}C	8 weeks to extraction; 40 days from extraction to analysis

Matrix	Analytical Group	Preparation Method/ Analytical Method/ SOP Reference [1]	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Sediment	Select Metals	SW-846 3050B/6010C/ Lab SOPs 4, 10	4 oz wide-mouth jar	1-3 g	Cool to 6^oC	180 days to analysis (ICP metals)
	Grain Size[2]	ASTM D422, Lab SOP 16	8 oz wide-mouth jar	> 100 g	Cool to 6^oC	NA
	Bulk Density[2]	ASTM D2937, SOP 17	1 foot section of undistributed sediment within capped tube	> 100 g	Cool to 6^oC	NA
	Atterberg Limits[2]	ASTM D4318, SOP 18	8 oz wide-mouth jar	200g	Cool to 6^oC	NA
	Specific Gravity[2]	ASTM D854, SOP 19	8 oz wide-mouth jar	100g	Cool to 6^oC	NA
	Organic Content[2]	ASTM D2974, SOP 20	8 oz wide-mouth jar	>50g	Cool to 6^oC	NA
	Gravity Drainage Test[2]	Gravity Drainage Test, Geotesting Express-S1026, SOP 21	Air-tight 5-gallon container	5 gallons	Air-tight containers to minimize moisture loss	NA
	Pillow Test for Geotextile Bags[2]	Geosynthetic Research Institute (GRI) Test Method GT 15, SOP 22	Air-tight 5-gallon container	10 gallons	Air-tight containers to minimize moisture loss	NA

Footnotes:
1 See Analytical SOP References table (Section 10) for additional details on SOPs.
2 Will be analyzed by GeoTesting Express, a subcontractor to Mitkem. No further quality control information is presented for these analyses in this SAP.

Table 8-3 - Field Quality Control Sample Summary Table

Matrix	Analytical Group[(1)]	No. of Samples (Immediate Analysis/Hold for Analysis)[(2)]	No. of Field Duplicates[(3)]	No. of MS/MSDs[(4)]	Equipment Rinsate Blanks[(5)]	Total No. of Samples to Lab
Sediment	PAHs	68/21	7	5/5	5	101
	PCB Congeners	68/21	7	5/5	5	101
	Pesticides	68/21	7	5/5	5	101
	Metals	68/21	7	5/5	5	101
	Grain size	6	0	0	0	6
	Bulk density	6	0	0	0	6
	Atterberg Limits	6	0	0	0	6
	Specific Gravity	6	0	0	0	6
	Organic Content	6	0	0	0	6
	Gravity Drainage Test	2	0	0	0	2
	Pillow Test for Geotextile Bags	2	0	0	0	2

Footnotes:

1 Not all analyses are performed on every sample. Refer to Table 8-1 for analyses per sample location.
2 Each sampling depth from a sampling location counted as a separate sample.
3 Field duplicate pairs only collected from samples for immediate analysis.
4 Although MS/MSDs are not typically considered field QC samples, they are included here because location determination is often established in the field. The MS/MSDs are not included in the total number of samples sent to the laboratory.
5 Equipment rinsate blanks will be collected if non-dedicated sampling equipment is used. For disposable equipment, one sample per batch of disposable equipment will be collected.

9.0 -- Reference Limits and Evaluation Tables

(UFP-QAPP Manual Section 2.8.1 – Worksheet #15)

Matrix: Sediment

Analyte	CAS Number	Project Action Limit		Project Quantitation Limit Goal	Mitkem		
		Value	Source		Limit of Quantitation (LOQ)	Limit of Detection (LOD)	Detection Limit (DL)
PAHs (µg/kg)							
2-Methylnaphthalene	91-57-6	670	ER-M	223	330	66	42
Acenaphthene	83-32-9	500	ER-M	167	330	66	39
Acenaphthylene	208-96-8	640	ER-M	213	330	66	37
Anthracene	120-12-7	1100	ER-M	367	330	66	27
Benzo(a)anthracene	56-55-3	1600	ER-M	533	330	66	33
Benzo(a)pyrene	50-32-8	1600	ER-M	533	330	66	31
Chrysene	218-01-9	2800	ER-M	933	330	66	29
Dibenzo(a,h)anthracene	**53-70-3**	**260**	**ER-M**	**87**	**330**	**66**	**35**
Fluoranthene	206-44-0	5100	ER-M	1700	330	66	29
Fluorene	86-73-7	540	ER-M	180	330	66	33
Naphthalene	91-20-3	2100	ER-M	700	330	66	41
Phenanthrene	85-01-8	1500	ER-M	500	330	66	26
Pyrene	129-00-0	2600	ER-M	867	330	66	32
Pesticides (µg/kg)							
alpha-Chlordane	5103-71-9	6(2)	ER-M	2	1.7	0.087	0.087
4,4'-DDE	72-55-9	27	ER-M	9	3.3	0.25	0.25
4,4'-DDD	72-54-8	20	ER-M	7	3.3	0.22	0.22
4,4'-DDT	50-29-3	7	ER-M	2	3.3	0.33	0.33
PCB Congeners (µg/kg)							
PCB-8	34883-43-7	5	ER-M(1)	2	5	1.7	1.2
PCB-18	37680-65-2	5	ER-M(1)	2	5	0.67	0.33
PCB-28	7012-37-5	5	ER-M(1)	2	5	0.67	0.27
PCB-44	41464-39-5	5	ER-M(1)	2	5	0.67	0.36
PCB-52	35693-99-3	5	ER-M(1)	2	5	0.67	0.24
PCB-66	32598-10-0	5	ER-M(1)	2	5	0.67	0.33

Analyte	CAS Number	Project Action Limit		Project Quantitation Limit Goal	Mitkem		
		Value	Source		Limit of Quantitation (LOQ)	Limit of Detection (LOD)	Detection Limit (DL)
PCB-101	37680-73-2	5	ER-M(1)	2	5	0.67	0.33
PCB-105	32598-14-4	5	ER-M(1)	2	5	0.67	0.19
PCB-118	31508-00-6	5	ER-M(1)	2	5	0.67	0.33
PCB-128	38380-07-3	5	ER-M(1)	2	5	0.67	0.33
PCB-138	35065-28-2	5	ER-M(1)	2	5	0.67	0.33
PCB-153	35065-27-1	5	ER-M(1)	2	5	0.67	0.41
PCB-170	35065-30-6	5	ER-M(1)	2	5	0.67	0.33
PCB-180	35065-29-3	5	ER-M(1)	2	5	0.67	0.33
PCB-187	52663-68-0	5	ER-M(1)	2	5	0.67	0.33
PCB-195	52663-78-2	5	ER-M(1)	2	5	0.67	0.33
PCB-206	40186-72-9	5	ER-M(1)	2	5	0.67	0.33
PCB-209	2051-24-3	5	ER-M(1)	2	5	0.67	0.33
Inorganics (mg/kg)							
Arsenic	7440-38-2	70	ER-M	23	1	0.5	0.41
Cadmium	7440-43-9	9.6	ER-M	3	0.25	0.075	0.015
Chromium	7440-47-3	370	ER-M	123	1	0.050	0.019
Copper	7440-50-8	270	ER-M	90	1.5	0.25	0.11
Lead	7439-92-1	218	ER-M	73	0.5	0.25	0.17
Nickel	7440-02-0	51.6	ER-M	17	2.5	0.050	0.043
Selenium	**7782-49-2**	**1.4(3)**	**ER-M**	**0.5**	**1.5**	**1**	**0.64**
Zinc	7440-66-6	410	ER-M	137	2.5	0.38	0.18

Notes:
Bolded and shaded rows indicate that the project action limit (PAL) is between the LOQ and LOD.
CAS – Chemical Abstracts Service
ER-M – Effects Range-Median (Long et al, 1995, except where noted)

1 - ER-M for total PCB congeners divided by 18 congeners divided by 2.
2 - Long and Morgan, 1991.
3 - Wolfenden and Carlin, 1992.

10.0 -- Analytical SOP Reference Table

(UFP-QAPP Manual Section 3.2.1 – Worksheet #23)

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to DoD Quality Systems Manual (QSM)? (Y OR N)	Modified for Project Work? (Y/N)
1	70.0011, Semivolatiles by Method 8270D Rev 10, 5/09	Definitive	Solid/PAHs	Gas Chromatograph/Mass Spectrometer (GC/MS)	Mitkem Laboratories	N	N
2	60.0006, Pesticides by Method 8081B, Rev. 10, 4/11	Definitive	Solid/Pesticides	Gas Chromatograph/ Electron Capture Detector (GC/ECD)	Mitkem Laboratories	N	N
3	60.0003, PCBs by Method 8082A, Rev. 10, 4/11	Definitive	Solid /PCB Congeners	GC/ECD	Mitkem Laboratories	N	N
4	100.0111, Metals by ICP/AES Method 6010C, Rev 13, 12/10	Definitive	Solid/ICP Metals	Inductively Coupled Plasma- Atomic Emission Spectroscopy (ICP-AES)	Mitkem Laboratories	N	N
5	110.0038, Percent Moisture, Rev 8, 2/11	Definitive	Solid/Percent Moisture	Oven	Mitkem Laboratories	N	N
6	50.0052, Organic Preparation of Soil Samples by Sonication, Method 3550B, Rev 3, 2/10	Definitive	Solid/PAHs, Pesticides, PCB	Not Applicable (NA)	Mitkem Laboratories	N	N
7	50.0053, Organic Preparation of Soil Samples by Soxhlet, Method 3540C, Rev 3, 2/10	Definitive	Solid/PAHs, Pesticides, PCB	NA	Mitkem Laboratories	N	N
8	50.0100, Organic Preparation of Soil Samples by MSE, Method 3570, Rev 2, 2/10	Definitive	Solid/PAHs, Pesticides, PCB	NA	Mitkem Laboratories	N	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to DoD Quality Systems Manual (QSM)? (Y OR N)	Modified for Project Work? (Y/N)
9	50.0054, Organic Extract Filtration and Concentration Techniques, Rev 2, 2/10	Definitive	Solid/PAHs, Pesticides, PCB	NA	Mitkem Laboratories	N	N
10	100.0104, Sample Preparation of Soils by Acid Digestion for ICP, Method 3050B, Rev 8, 3/10	Definitive	Solid/ICP Metals	NA	Mitkem Laboratories	N	N
11	30.0003, Sample Receipt, Storage, Tracking and Disposal, Rev 15, 8/10	Definitive	All Laboratory	NA	Mitkem Laboratories	N	N
12	30.0024, Sample Disposal, Rev 9, 6/11	Definitive	All Laboratory	NA	Mitkem Laboratories	N	N
13	50.0050, Preparation of Aqueous Samples by Continuous Liquid-Liquid Extraction, Method 3520C, Rev 6, 4/11	Definitive	Aqueous/ PAHs, Pesticides, PCB	NA	Mitkem Laboratories	N	N
14	50.0051, Preparation of Aqueous Samples by Separatory Funnel Extraction, Method 3510C, Rev 2, 2/10	Definitive	Aqueous/ PAHs, Pesticides, PCB	NA	Mitkem Laboratories	N	N
15	100.0003, Sample Preparation of Aqueous Samples by Acid Digestion ICP (3005A/3010)ICP, Rev 8, 2/10	Definitive	Aqueous/ Metals	NA	Mitkem Laboratories	N	N
16	ASTM D422- Revision 7, 9/10	Screening	Sediment/ Grain Size	Sieve and Hydrometer	GeoTesting Express	N	N
17	ASTM D2937- Revision 4, 9/10	Screening	Sediment/ Bulk Density	Drive Cylinder	GeoTesting Express	N	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to DoD Quality Systems Manual (QSM)? (Y OR N)	Modified for Project Work? (Y/N)
18	ASTM D4318 – Revision 5, 7/11	Screening	Sediment/ Atterberg Limits	NA	GeoTesting Express	N	N
19	ASTM D854 – Revision 6, 7/11	Screening	Sediment/ Specific Gravity	NA	GeoTesting Express	N	N
20	ASTM D2974 – Revision 3, 9/10	Screening	Sediment/ Organic Content	NA	GeoTesting Express	N	N
21	Geotesting Express – S1026 Gravity Drainage Test	Screening	Sediment/ Gravity Drainage	NA	GeoTesting Express	N	N
22	GRI test method GT15 - The Pillow Test for Field Assessment of Fabrics/Additives Used for Geotextile Bags, Containers, and Tubes;8/09	Screening	Sediment/Pillow Test for Geotextile Bags	NA	GeoTesting Express	N	N

11.0 -- Laboratory QC Samples Tables

(UFP-QAPP Manual Section 3.4 – Worksheet #28)

Matrix	Soil, Sediment, Aqueous
Analytical Group	PAHs – Full Scan
Analytical Method/SOP Reference	SW846 8270D/SOP Number 1

QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	Contaminants in the method blank must be < ½ LOQ.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result for project-critical analytes. Contact Client if samples cannot be re-prepared within hold time. Discuss in narrative.	Analyst, Laboratory Department Manager	Bias/ contamination	Same as Method/SOP QC Acceptance Limits.
Surrogates	Six for Full Scan: 2,4,6-Tribromophenol, 2-Fluorobiphenyl, 2-Fluorophenol, Nitrobenzene-d5, Phenol-d5 and Terphenyl-d14.	Percent Recovery (%R) must meet the DoD QSM specified control limits. Current limits are provided in QSM *Appendix G.* One surrogate out allowed per fraction (>10%R).	For QC and field samples, correct problem then re-prepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic or matrix interference with surrogate is present, reanalysis may not be necessary. Discuss in narrative. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous
Analytical Group	PAHs – Full Scan
Analytical Method/SOP Reference	SW846 8270D/SOP Number 1

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Control Sample (LCS) Laboratory Control Sample Duplicate (LCSD)	One per preparation batch of 20 or fewer samples of similar matrix. One LCSD per prep batch of twenty or fewer samples of similar matrix if no MS/MSD in batch.	%R must meet the DoD QSM specified control limits. Current limits are provided in QSM *Appendix G.* Also refer to Table G-1 for marginal exceedance criteria. RPD ≤ 30%	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed project critical analytes, if sufficient sample material is available. Discuss in narrative. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per SDG or every 20 samples as identified by sampler.	%R should meet the DoD QSM specified control limits. Current limits are provided in QSM *Appendix G.* Precision RPD ≤ 30%	Check LCS and instrument performance. Corrective actions will not be taken for samples when recoveries are outside limits if likely due to matrix, otherwise contact client and/or discuss in narrative.	Analyst, Laboratory Department Manager	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous					
Analytical Group	PAHs – Full Scan					
Analytical Method/SOP Reference	SW846 8270D/SOP Number 1					
QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Internal Standards	Full Scan uses six per sample –1,4-Dichlorobenzene-d4 Naphthalene-d8 Acenaphthene-d10 Phenanthrene-d10 Chrysene-d12 Perylene-d12.	Retention times for internal standards must be ± 30 seconds and the responses within -50% to +100% of the initial calibration midpoint.	Inspect mass spectrometer or gas chromatograph for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning unless obvious chromatographic or matrix interference.	Analyst, Laboratory Department Manager	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply “J” qualifier to results detected between DL and LOQ.	NA.	Analyst, Laboratory Department Manager	Accuracy	Same as QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous					
Analytical Group	PCB Congeners					
Analytical Method/ SOP Reference	SW846 8082A/SOP No. 3					
QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	Contaminants in the method blank must be < ½ LOQ.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result for project-critical analytes. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager	Bias/ contamination	Same as Method/SOP QC Acceptance Limits.
Surrogates	Tetrachloro-m-xylene	%R must be between 30-150%.	For lab QC samples, correct problem then re-prepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. For field samples high bias surrogate recovery in samples with no positive hits is allowed. If obvious chromatographic or matrix interference with surrogate is present, reanalysis may not be necessary. Discuss in narrative. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous
Analytical Group	PCB Congeners
Analytical Method/ SOP Reference	SW846 8082A/SOP No. 3

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS/LCSD	One per preparation batch of 20 or fewer samples of similar matrix. One LCSD per prep batch of twenty or fewer samples of similar matrix if no MS/MSD in batch.	%R must be between 50-130%. RPD must be≤ 40%.	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed project critical analytes, if sufficient sample material is available. Discuss in narrative. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per SDG or every 20 samples as identified by sampler.	%R must be between 50-130%. RPD must be≤ 30%.	Check LCS and instrument performance. Corrective actions will not be taken for samples when recoveries are outside limits if likely due to matrix, otherwise contact client and/or discuss in narrative.	Analyst, Laboratory Department Manager	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Second Column Confirmation	All positive results must be confirmed.	Results between primary and second column must be RPD ≤ 40%. The lower of the two results will be reported on the Form 1, with both results reported on Form 10, unless matrix interference is apparent.	None. Apply qualifier if RPD >40% and discuss in the case narrative.	Analyst, Laboratory Department Manager	Precision	Same as Method/SOP QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous
Analytical Group	PCB Congeners
Analytical Method/ SOP Reference	SW846 8082A/SOP No. 3

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Results between DL and LOQ	NA	Apply “J” qualifier to results detected between DL and LOQ.	NA.	Analyst, Laboratory Department Manager	Accuracy	Same as QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous					
Analytical Group	Pesticides					
Analytical Method/ SOP Reference	SW846 8081B/SOP No. 2					
QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	Contaminants in the method blank must be < ½ LOQ.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result for project-critical analytes. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager	Bias/ contamination	Same as Method/SOP QC Acceptance Limits.
Surrogates	Two per sample: Decachloro-biphenyl and Tetrachloro-m-xylene	%R must meet the DoD QSM specified control limits. Current limits are provided in QSM *Appendix G.*	For lab QC samples, correct problem then re-prepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. For field samples one surrogate must be within QC limits. High bias surrogate in samples with no positive hits is allowed. If obvious chromatographic or matrix interference with surrogate is present, reanalysis may not be necessary. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous
Analytical Group	Pesticides
Analytical Method/ SOP Reference	SW846 8081B/SOP No. 2

QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
LCS/LCSD	One per preparation batch of 20 or fewer samples of similar matrix. One LCSD per prep batch of twenty or fewer samples of similar matrix if no MS/MSD in batch.	%R must meet the DoD QSM specified control limits. Current limits are provided in QSM *Appendix G.* Precision RPD ≤ 30%.	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed project critical analytes, if sufficient sample material is available. Contact Client if samples cannot be re-prepared within hold time.	Analyst, Laboratory Department Manager	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per SDG or every 20 samples as identified by sampler.	%R must meet the DoD QSM specified control limits. Current limits are provided in QSM *Appendix G.* Precision RPD ≤ 30%.	Check LCS and instrument performance. Corrective actions will not be taken for samples when recoveries are outside limits if likely due to matrix, otherwise contact client and/or discuss in narrative.	Analyst, Laboratory Department Manager	Precision/ Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous
Analytical Group	Pesticides
Analytical Method/ SOP Reference	SW846 8081B/SOP No. 2

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Second Column Confirmation	All positive results must be confirmed.	Results between primary and second column must be RPD ≤ 40%. The lower of the two results will be reported on the Form 1, with both results reported on Form 10, unless matrix interference is apparent.	None. Apply qualifier if RPD >40% and discuss in the case narrative.	Analyst, Laboratory Department Manager	Precision	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply “J” qualifier to results detected between DL and LOQ.	NA.	Analyst, Laboratory Department Manager	Accuracy	Same as QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous
Analytical Group	Metals
Analytical Method/SOP Reference	SW-846 6010C/ SOP No. 4

QC Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No target metals > ½ LOQ. For negative blanks, absolute value < LOD	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-digest and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result	Analyst, Laboratory Department Manager	Contamination / Bias	Same as Method/SOP QC Acceptance Limits.
LCS	One per each batch of up to 20 samples of the same matrix.	%Rs must be within 80-120%, with silver 75-120%.	Re-digest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager	Accuracy	Same as Method/SOP QC Acceptance Limits.
Sample Duplicate	One per SDG or every 20 samples as identified by sampler.	%RPD should be < 20%.	Flag results for affected analytes for all associated samples, discuss in narrative.	Analyst, Laboratory Department Manager	Precision	Same as Method/SOP QC Acceptance Limits.
Matrix Spike	One per SDG or every 20 samples as identified by sampler.	%R should be within 80-120% if sample < 4x spike added.	Flag results for affected analytes for all associated samples with "N", discuss in narrative.	Analyst, Laboratory Department Manager	Accuracy	Same as Method/SOP QC Acceptance Limits.
Serial Dilution (**for ICP only**)	One serial dilution (5x) is performed for each batch of 20 samples of the same matrix.	Five-fold dilution must agree within ± 10% of the original measurement if the result is >50xLOD.	Perform post-digestion spike addition.	Analyst, Laboratory Department Manager	Precision	Same as Method/SOP QC Acceptance Limits.

Matrix	Soil, Sediment, Aqueous					
Analytical Group	Metals					
Analytical Method/SOP Reference	SW-846 6010C/ SOP No. 4					
QC Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Post-Digestion Spike (**for ICP only**)	Project-specific frequency: When MS recovery fails or analyte concentration in all samples < 50x LOD	%R must be within 75-125% to verify the absence of interference.	Qualify results and note in narrative.	Analyst, Laboratory Department Manager	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply “J” qualifier to results detected between DL and LOQ.	NA.	Analyst, Laboratory Department Manager	Accuracy	Same as QC Acceptance Limits.

1 Please note that limits are updated periodically and may change from the issuance of the final SAP to the time data validation is performed. The limits used for validation will be the limits that are current at the time of analysis.

12.0 -- Data Verification and Validation (Steps I and IIa/IIb) Process Table

(UFP-QAPP Manual Section 5.2.1, UFP-QAPP Manual Section 5.2.2,, Figure 37 UFP-QAPP Manual, Table 9 UFP-QAPP Manual – Worksheets #34, 35, 36)

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Chain of Custody Forms	The Tetra Tech FOL or designee will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, the Tetra Tech PM, and the Tetra Tech Data Validators. The Tetra Tech FOL or designee will review the chain-of-custody form to verify that all samples listed in the SAP have been collected. All deviations should be documented in the report.	Sampler and FOL, Tetra Tech	Internal
Chain of Custody Forms	1 - The Laboratory Sample Custodian will review the sample shipment for completeness and integrity, and sign accepting the shipment. 2- The Tetra Tech Data Validators will check that the chain-of-custody form was signed and dated by the Tetra Tech FOL or designee relinquishing the samples and also by the Laboratory Sample Custodian receiving the samples for analyses.	1 - Laboratory Sample Custodian, Mitkem 2 - Data Validators, Tetra Tech	1 - External 2 - External
Chain of Custody Forms and SAP	Ensure that the custody and integrity of the samples was maintained from collection to analysis and the custody records are complete and any deviations are recorded. Review that the samples were shipped and stored at the required temperature and preservation conditions for chemically-preserved samples meet the requirements listed in the SAP. Ensure that the analyses were performed within the holding times listed in the SAP.	Data Validators, Tetra Tech	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
Sample Log Sheets, Chain of Custody Forms, SAP, and Laboratory sample login documentation	Verify that information recorded in the log sheets is accurate and complete. Verify that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain-of-custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented. Document any discrepancies in the final report.	PM, FOL, or designee, Tetra Tech	Internal
SAP, Analytical SOPs, and Analytical Data Packages	Ensure that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied. Establish that all method QC samples were analyzed and in control as listed in the analytical SOPs. If method QA is not in control, the Laboratory QAM will contact the Tetra Tech PM verbally or via e-mail for guidance prior to report preparation.	Laboratory QAM, Mitkem	Internal
SAP/Chain-of-Custody Forms	Check that all field QC samples determined necessary were collected as required.	FOL or designee, Tetra Tech	Internal
Analytical Data Package	Verify all analytical data packages for completeness. The Laboratory QAM will sign the case narrative for each data package.	Laboratory QAM, Mitkem	Internal
Electronic Data Deliverables (EDDs)/Analytical Data Packages	Check each EDD against the chain-of-custody and hard copy data package for accuracy and completeness. Compare laboratory analytical results to the electronic analytical results to verify accuracy. Evaluate sample results for laboratory contamination and qualify false detections using the laboratory method/preparation blank summaries. Qualify analyte concentrations between the DL and the LOQ as estimated. Remove extraneous laboratory qualifiers from the validation qualifier.	Data Validators, Tetra Tech	External
Analytical Data Package	Verify each data package for completeness. Request missing information from the Laboratory PM.	Data Validators, Tetra Tech	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
SAP/Laboratory Data Packages/EDDs	Ensure that the laboratory QC samples were analyzed and that the MPCs listed in were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Data Validators, Tetra Tech	External
SAP/Laboratory Data Packages/EDDs	Check the field sampling precision by calculating RPDs for field duplicate samples. Check laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSD, if available. Ensure compliance with the methods and project MPCs accuracy goals listed in the SAP.	Data Validators, Tetra Tech	External
SAP/Laboratory Data Packages/EDDs	Check that the laboratory recorded the temperature at sample receipt and the pH of samples preserved with acid or base to ensure sample integrity from sample collection to analysis.	Data Validators, Tetra Tech	External
SAP/Laboratory Data Packages/EDDs	Review the chain-of-custody forms generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. The Tetra Tech Data Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Check that all data have been transferred correctly and completely to the Tetra Tech structured query language (SQL) database.	Data Validators, Tetra Tech	External
SAP/Laboratory Data Packages/EDDs	Ensure that the project LOQs listed in SAP were achieved.	Data Validators, Tetra Tech	External

Data Review Input	Description	Responsible for Verification (name, organization)	Internal/ External
SAP/Laboratory Data Packages/EDDs	Discuss the impact on DLs that are elevated because of matrix interferences. Be especially cognizant of and evaluate the impact of sample dilutions on low-concentration analytes when the dilution was performed because of the high concentration of one or more other contaminants. Document this usability issue and inform the Tetra Tech PM. Review and add PALs to the laboratory EDDs. Flag samples and notify the Tetra Tech PM of samples that exceed PALs listed in SAP.	Data Validators, Tetra Tech	External
SAP/Laboratory Data Packages/EDDs	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Ensure that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the Laboratory QAM shall have contacted the Tetra Tech PM.	Data Validators, Tetra Tech	External
SAP/Laboratory Data Packages/EDDs	Summarize deviations from methods, procedures, or contracts in the Data Validation Report. Determine the impact of any deviation from sampling or analytical methods and SOPs requirements and matrix interferences effect on the analytical results. Qualify data results based on method or QC deviation and explain all the data qualifications. Print a copy of qualified data stored the project database to depict data qualifiers and data qualifier codes that summarize the reason for data qualifications. Determine if the data met the MPCs and determine the impact of any deviations on the technical usability of the data.	Data Validators, Tetra Tech	External

12.1 VALIDATION SUMMARY

One hundred percent of the laboratory data for total metals will undergo a USEPA Region I Tier III validation, as defined in the Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part I, Attachment B, “Region 1 Tiered Organic and Inorganic Data

Validation Guidelines", July 1, 1993, Draft (USEPA, 1996). Project-specific criteria for total metals as listed in this SAP and the DOD QSM will be used to validate data. The logic outlined in Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, November 2008 (USEPA, 2008) will be used to apply qualifiers to data to the extent possible. The final data validation report will include a technical memorandum, qualified analytical results, results reported by the laboratory, Region I worksheets (where appropriate), and documentation to support data qualification. All data will be flagged by an appropriate qualifying symbol. Tetra Tech Data Validation Chemists will perform this task internally.

One hundred percent of the laboratory data for pesticides and PCB congeners will undergo a USEPA Region I Tier III validation, as defined in the Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part I, Attachment B, "Region 1 Tiered Organic and Inorganic Data Validation Guidelines", July 1, 1993, Draft (USEPA, 1996). Project-specific criteria for Pesticides and PCB congeners as listed in this SAP and the DOD QSM will be used to validate data. The logic outlined in Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part III, February 2004 (USEPA, 2004) will be used to apply qualifiers to data to the extent possible. The final data validation report will include a technical memorandum, qualified analytical results, results reported by the laboratory, Region I worksheets (where appropriate), and documentation to support data qualification. All data will be flagged by an appropriate qualifying symbol. Tetra Tech Data Validation Chemists will perform this task internally.

One hundred percent of the laboratory data for PAHs will undergo a USEPA Region I Tier III validation, as defined in the Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part I, Attachment B, "Region 1 Tiered Organic and Inorganic Data Validation Guidelines", July 1, 1993, Draft (USEPA, 1996). Project-specific criteria for PAHs as listed in this SAP and the DOD QSM will be used to validate data. The logic outlined in Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part II, December 1996 (USEPA, 1996) will be used to apply qualifiers to data to the extent possible. The final data validation report will include a technical memorandum, qualified analytical results, results reported by the laboratory, Region I worksheets (where appropriate), and documentation to support data qualification. All data will be flagged by an appropriate qualifying symbol. Tetra Tech Data Validation Chemists will perform this task internally.

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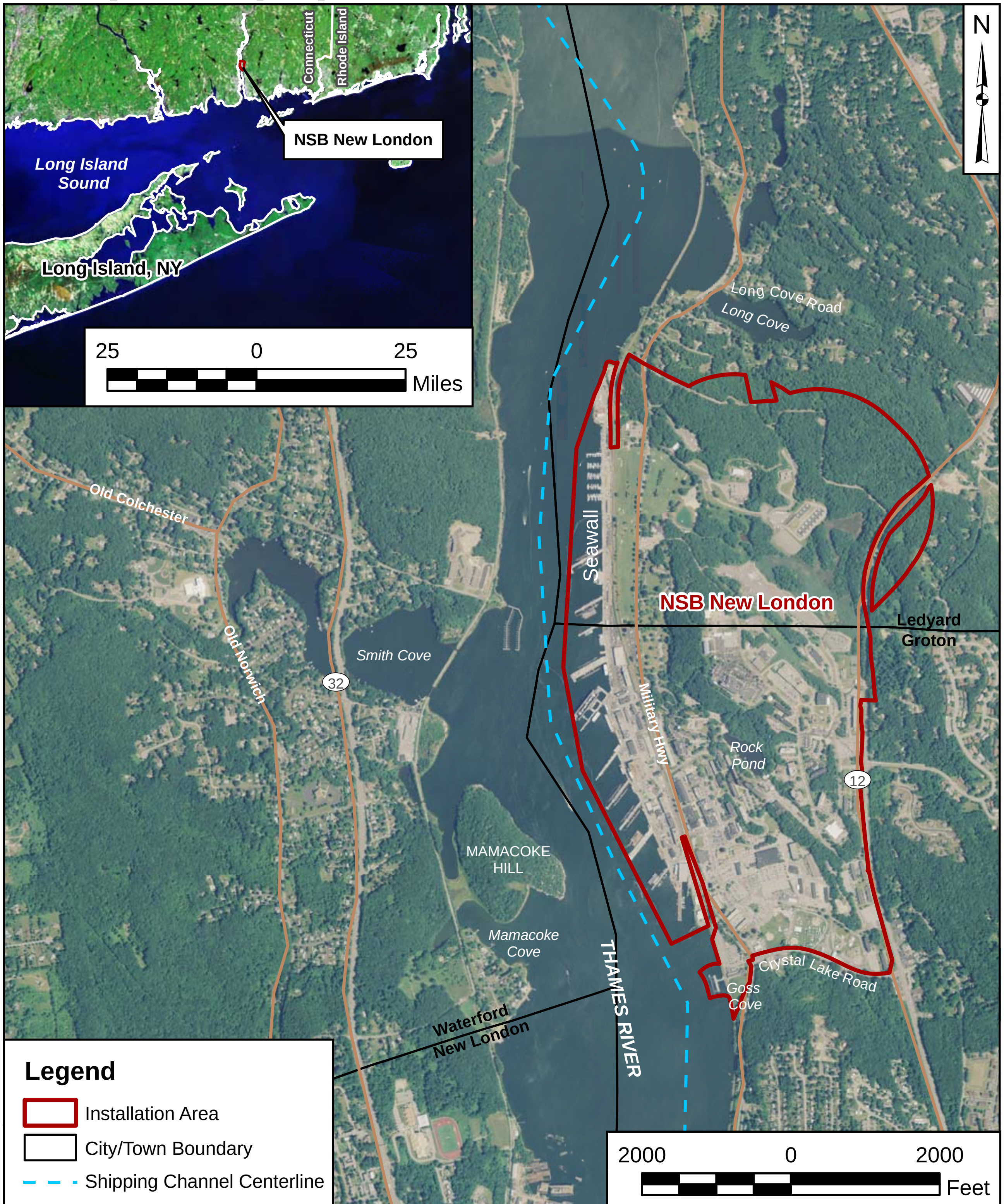


DRAWN BY S. STROZ — DATE 06/09/11	TETRA TECH	CONTRACT NUMBER CTO WE34
CHECKED BY L. GANSER — DATE 07/05/11	FACILITY LOCATION MAP NAVAL SUBMARINE BASE - NEW LONDON GROTON, CONNECTICUT	APPROVED BY CAR — DATE 07/11/11
COST/SCHEDULE AREA		APPROVED BY ___ — DATE ___
SCALE AS NOTED		FIGURE NO. FIGURE 4-1 — REV 0

LEGEND:

——— SITE BOUNDARY

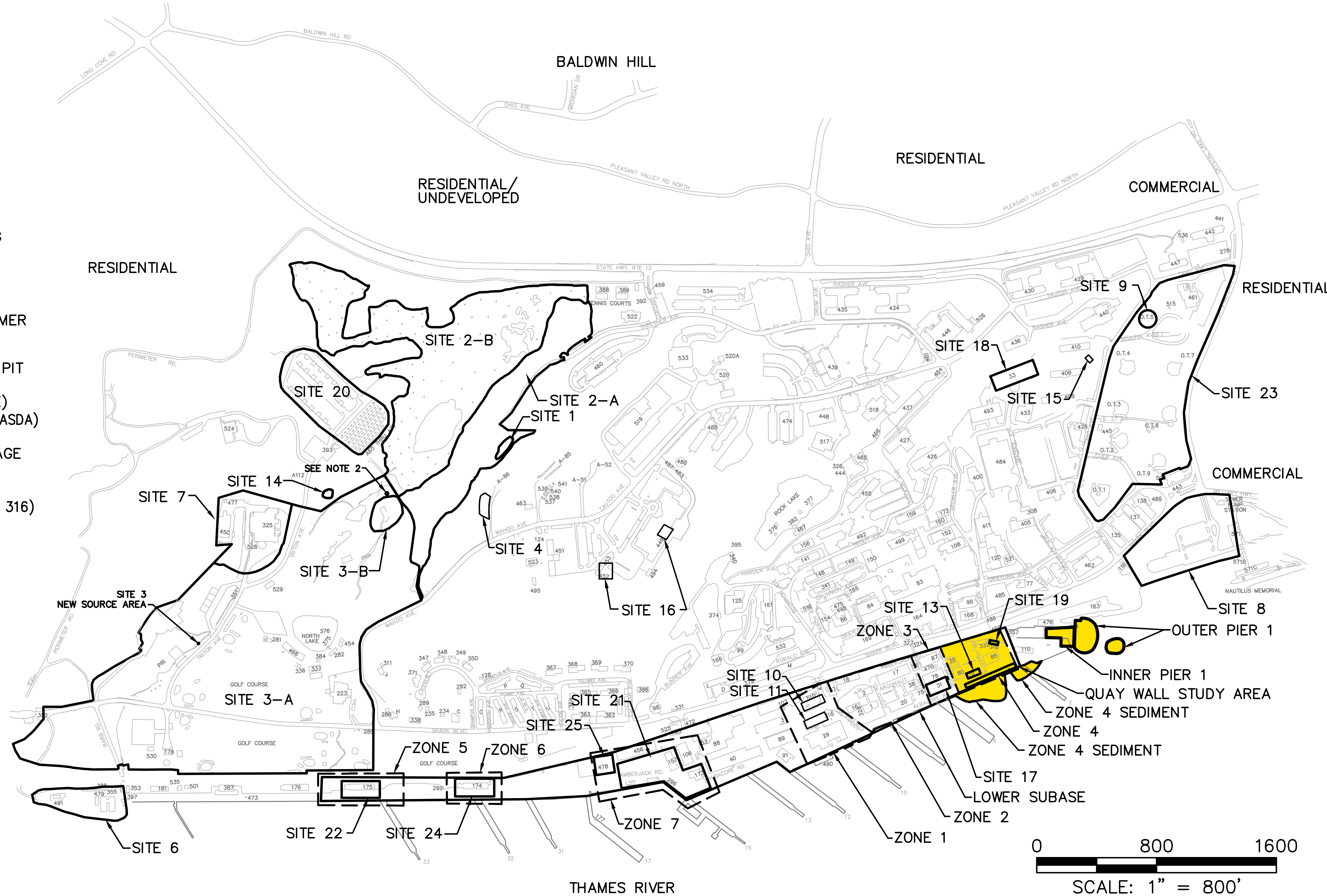
— — — LOWER SUBASE REMEDIAL INVESTIGATION ZONE BOUNDARY

SITE IDENTIFICATION:

SITE 1 – FORMER CONSTRUCTION BATTALION UNIT (CBU) DRUM STORAGE AREA
SITE 2 – (A) AREA A LANDFILL AND (B) AREA A WETLAND
SITE 3 – (A) AREA A DOWNSTREAM WATER COURSES AND (B) FORMER OVERBANK DISPOSAL AREA (OBDA)
SITE 4 – FORMER RUBBLE FILL AREA AT BUNKER A–86
SITE 6 – FORMER DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO)
SITE 7 – TORPEDO SHOPS
SITE 8 – GOSS COVE LANDFILL
SITE 9 – FORMER OILY WASTEWATER TANK (OT–5)
SITE 10 – LOWER SUBASE–FUEL STORAGE TANKS AND FORMER TANK 54–H
SITE 11 – LOWER SUBASE–POWER PLANT OIL TANKS
SITE 13 – LOWER SUBASE–BUILDING 79 FORMER WASTE OIL PIT AND INNER AND OUTER PIER 1
SITE 14 – OVERBANK DISPOSAL AREA NORTHEAST (OBDANE)
SITE 15 – FORMER SPENT ACID STORAGE AND DISPOSAL AREA (SASDA)
SITE 16 – FORMER HOSPITAL INCINERATORS
SITE 17 – FORMER HAZARDOUS MATERIALS/SOLVENT STORAGE AREA (FORMER BUILDING 31)
SITE 18 – SOLVENT STORAGE AREA (BUILDING 33)
SITE 19 – FORMER SOLVENT STORAGE AREA (FORMER BUILDING 316)
SITE 20 – AREA A WEAPONS CENTER
SITE 21 – BERTH 16
SITE 22 – PIER 33
SITE 23 – FORMER FUEL FARM
SITE 24 – CENTRAL PAINT ACCUMULATION
SITE 25 – LOWER SUBASE–FORMER CLASSIFIED MATERIALS INCINERATOR

NOTES:

1. SITE BOUNDARIES ARE APPROXIMATE.
2. LOCATION OF CONCRETE–CAPPED SOIL.
3. ZONE 4 BOUNDARY SHOWN IN YELLOW.



DRAWN BY BH	DATE 5/6/10
CHECKED BY NJB	DATE 5/6/10
REVISED BY	DATE
SCALE 1" = 800'	

Tetra Tech NUS, Inc.

SITE LOCATION MAP
NSB–NLON
GROTON, CONNECTICUT

CONTRACT NO. WE34	
OWNER NO. 3512	
APPROVED BY CAR	DATE 7/8/11
DRAWING NO. FIGURE 4–2	REV.

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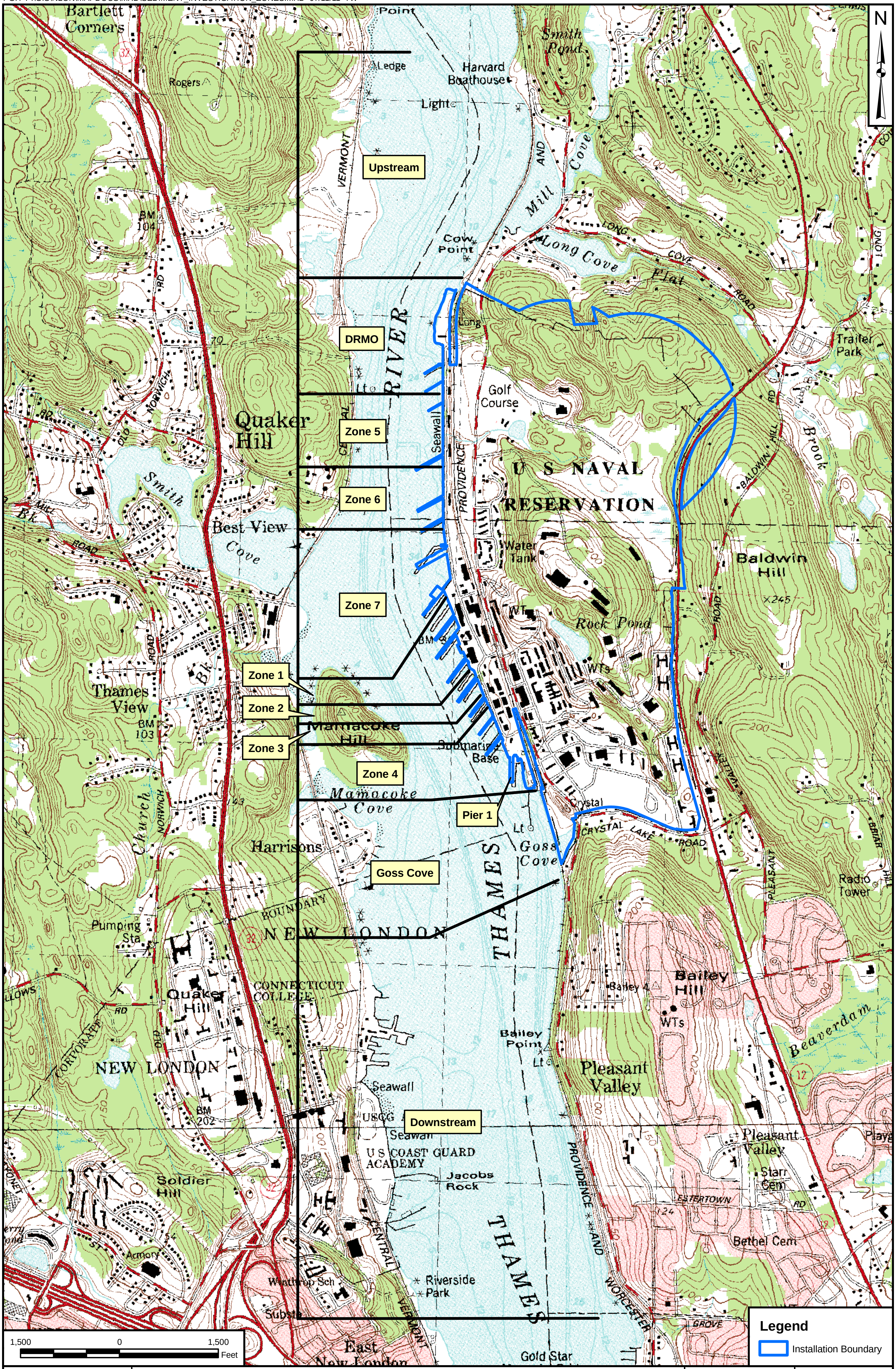

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J. ENGLISH	06/06/11	TETRA TECH	3512	WE34
CHECKED BY	DATE	SEDIMENT INVESTIGATION ZONES NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT	APPROVED BY	DATE
L. GANSER	07/11/11		CAR	07/11/11
REVISED BY	DATE		APPROVED BY	DATE
T. WHEATON	07/11/11		—	—
SCALE			FIGURE NO.	REV
AS NOTED			4-3	0

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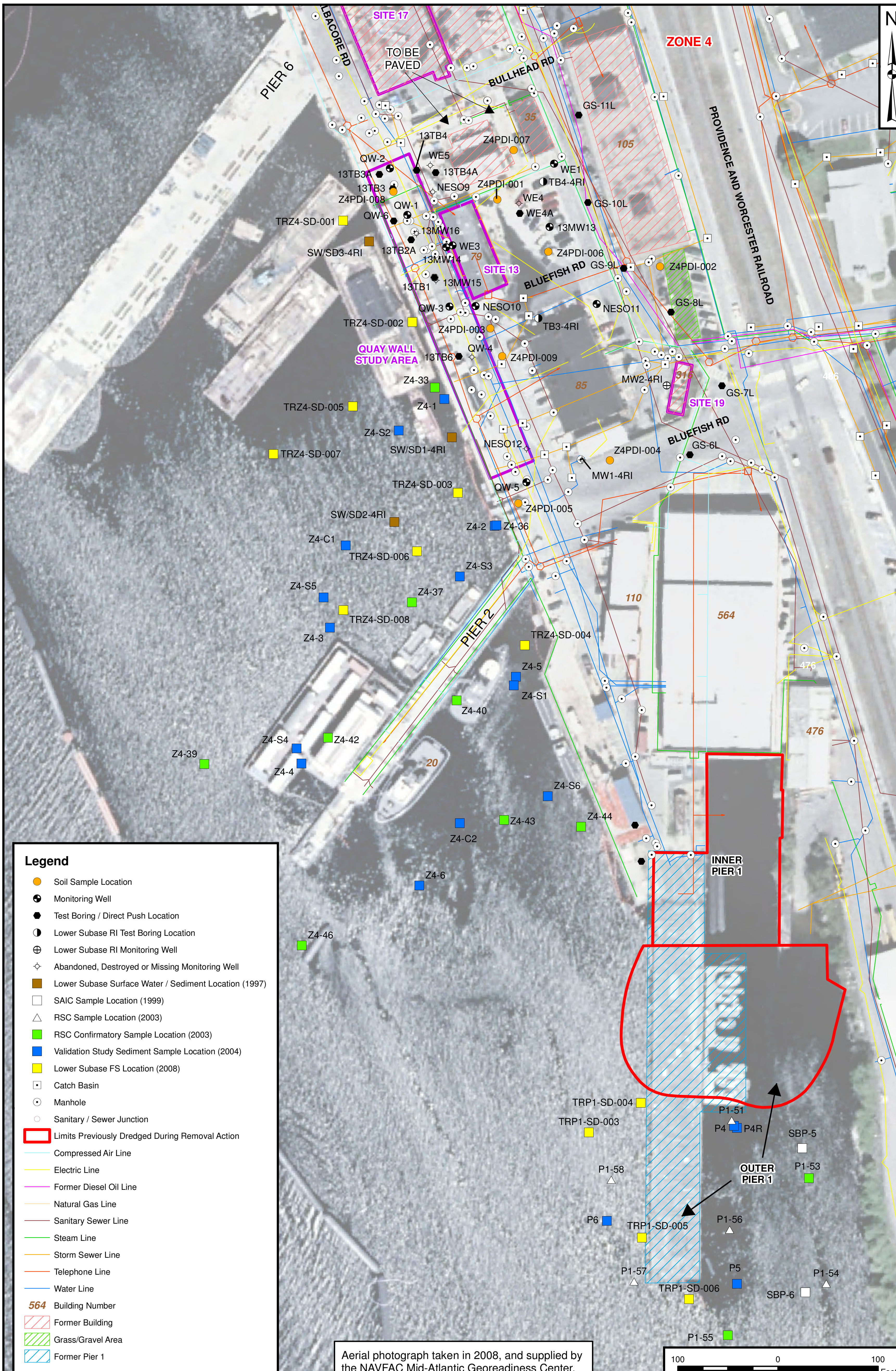
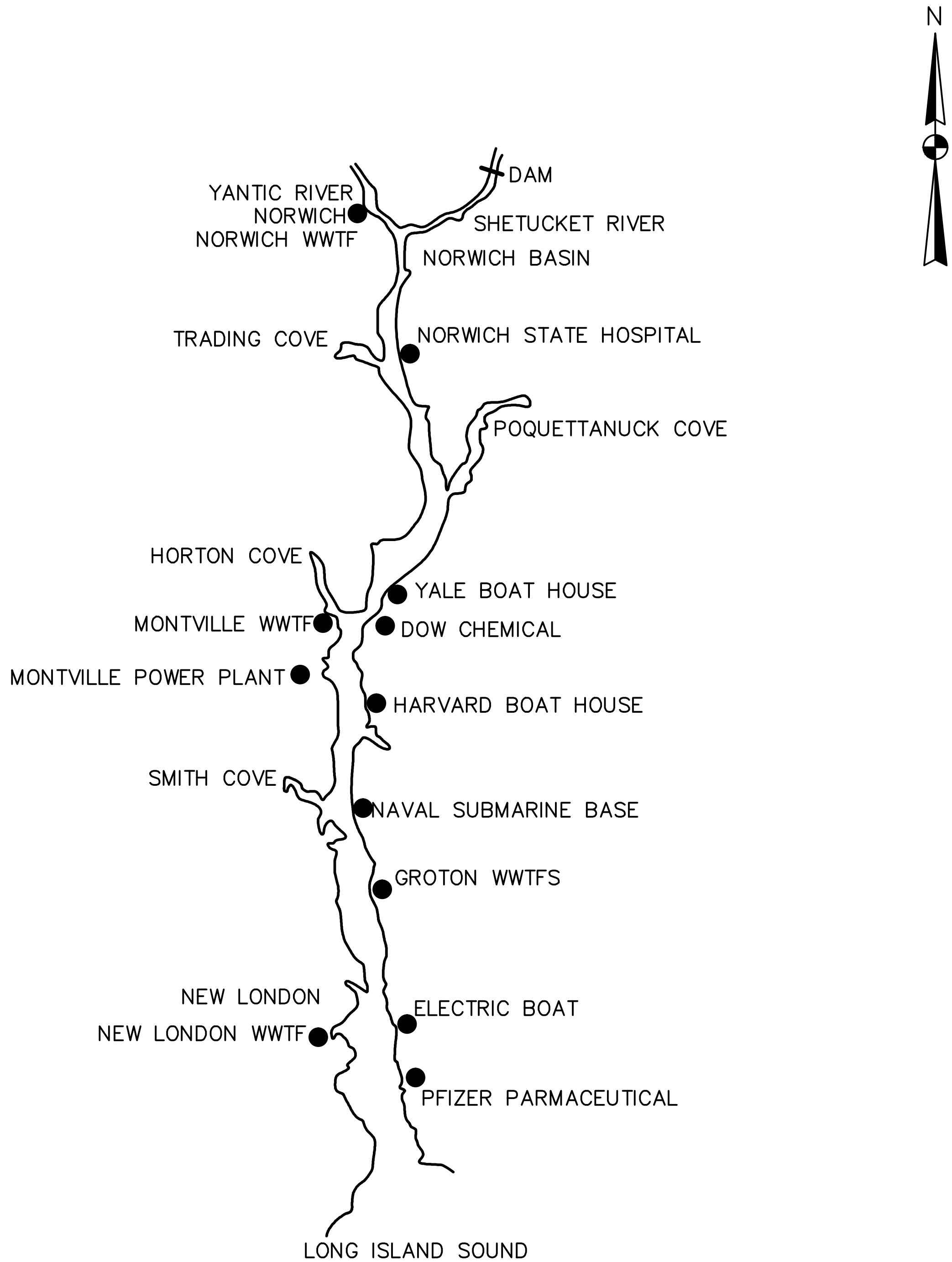


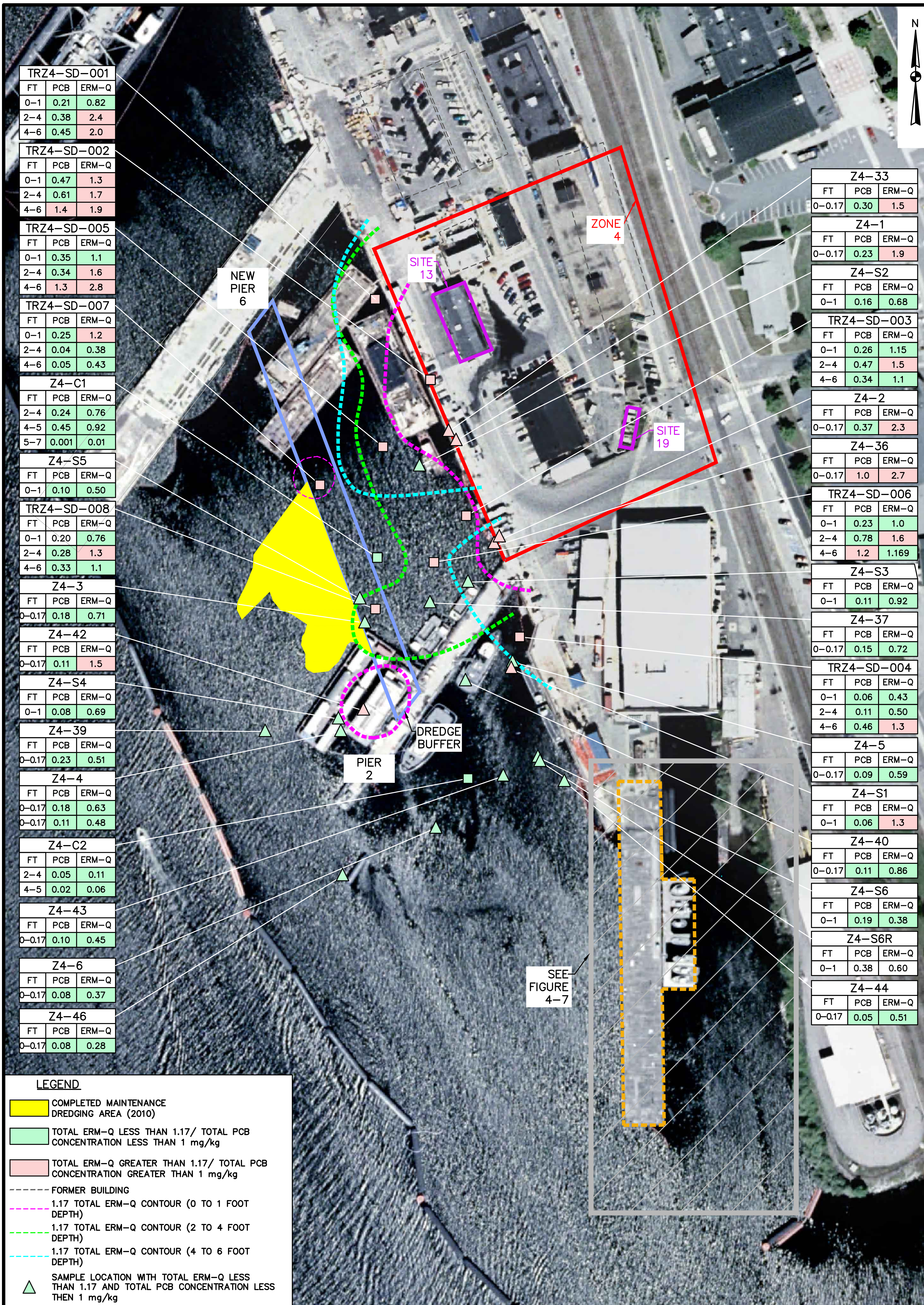
DRAWN BY	DATE	TETRA TECH	CONTRACT NUMBER	CTO NUMBER
S. STROZ	07/05/11		03512	WE34
CHECKED BY	DATE	ZONE 4 AND OUTER PIER 1 SAMPLE LOCATION MAP NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT	APPROVED BY	DATE
L. GANSER	03/09/12		L. GANSER	11/4/11
REVISED BY	DATE		APPROVED BY	DATE
S. PAXTON	03/09/12		__	__
SCALE			FIGURE NO.	REV
AS NOTED			FIGURE 4-4	0



LEGEND:

● DISCHARGE

DRAWN BY CK DATE 12/09/09	Tetra Tech NUS, Inc.	THAMES RIVER DISCHARGE SOURCES NSB–NLON, GROTON, CONNECTICUT	CONTRACT NO. 3512
CHECKED BY DATE			OWNER NO. WE34
REVISED BY DATE			APPROVED BY CAR DATE 7/8/11
SCALE NONE			DRAWING NO. FIGURE 4–5 REV. 0



Sample	FT	PCB	ERM-Q
TRZ4-SD-001	0-1	0.21	0.82
	2-4	0.38	2.4
	4-6	0.45	2.0
TRZ4-SD-002	0-1	0.47	1.3
	2-4	0.61	1.7
	4-6	1.4	1.9
TRZ4-SD-005	0-1	0.35	1.1
	2-4	0.34	1.6
	4-6	1.3	2.8
TRZ4-SD-007	0-1	0.25	1.2
	2-4	0.04	0.38
	4-6	0.05	0.43
Z4-C1	2-4	0.24	0.76
	4-5	0.45	0.92
	5-7	0.001	0.01
Z4-S5	0-1	0.10	0.50
TRZ4-SD-008	0-1	0.20	0.76
	2-4	0.28	1.3
	4-6	0.33	1.1
Z4-3	0-0.17	0.18	0.71
Z4-42	0-0.17	0.11	1.5
Z4-S4	0-1	0.08	0.69
Z4-39	0-0.17	0.23	0.51
Z4-4	0-0.17	0.18	0.63
	0-0.17	0.11	0.48
Z4-C2	2-4	0.05	0.11
	4-5	0.02	0.06
Z4-43	0-0.17	0.10	0.45
Z4-6	0-0.17	0.08	0.37
Z4-46	0-0.17	0.08	0.28

Sample	FT	PCB	ERM-Q
Z4-33	0-0.17	0.30	1.5
Z4-1	0-0.17	0.23	1.9
Z4-S2	0-1	0.16	0.68
TRZ4-SD-003	0-1	0.26	1.15
	2-4	0.47	1.5
	4-6	0.34	1.1
Z4-2	0-0.17	0.37	2.3
Z4-36	0-0.17	1.0	2.7
TRZ4-SD-006	0-1	0.23	1.0
	2-4	0.78	1.6
	4-6	1.2	1.169
Z4-S3	0-1	0.11	0.92
Z4-37	0-0.17	0.15	0.72
TRZ4-SD-004	0-1	0.06	0.43
	2-4	0.11	0.50
	4-6	0.46	1.3
Z4-5	0-0.17	0.09	0.59
Z4-S1	0-1	0.06	1.3
Z4-40	0-0.17	0.11	0.86
Z4-S6	0-1	0.19	0.38
Z4-S6R	0-1	0.38	0.60
Z4-44	0-0.17	0.05	0.51

LEGEND

- COMPLETED MAINTENANCE DREDGING AREA (2010)
- TOTAL ERM-Q LESS THAN 1.17/ TOTAL PCB CONCENTRATION LESS THAN 1 mg/kg
- TOTAL ERM-Q GREATER THAN 1.17/ TOTAL PCB CONCENTRATION GREATER THAN 1 mg/kg
- FORMER BUILDING
- 1.17 TOTAL ERM-Q CONTOUR (0 TO 1 FOOT DEPTH)
- 1.17 TOTAL ERM-Q CONTOUR (2 TO 4 FOOT DEPTH)
- 1.17 TOTAL ERM-Q CONTOUR (4 TO 6 FOOT DEPTH)
- △ SAMPLE LOCATION WITH TOTAL ERM-Q LESS THAN 1.17 AND TOTAL PCB CONCENTRATION LESS THEN 1 mg/kg
- △ SAMPLE LOCATION WITH TOTAL ERM-Q GREATER THAN 1.17 OR TOTAL PCB CONCENTRATION GREATER THEN 1 mg/kg
- △ ONLY SURFACE SAMPLE COLLECTED
- □ MULTIPLE DEPTHS COLLECTED

UNITS:

-DEPTH PRESENTED IN FEET
-ERM-Q VALUE IS UNITLESS
-PCB CONCENTRATION PRESENTED IN MG/KG

0 120 240
SCALE: 1" = 120'

TETRA TECH
WWW.TETRATECH.COM
661 ANDERSEN DRIVE - FOSTER PLAZA 7
PITTSBURGH, PA 15220
T: (412) 921-7090 | F: (412) 921-4040

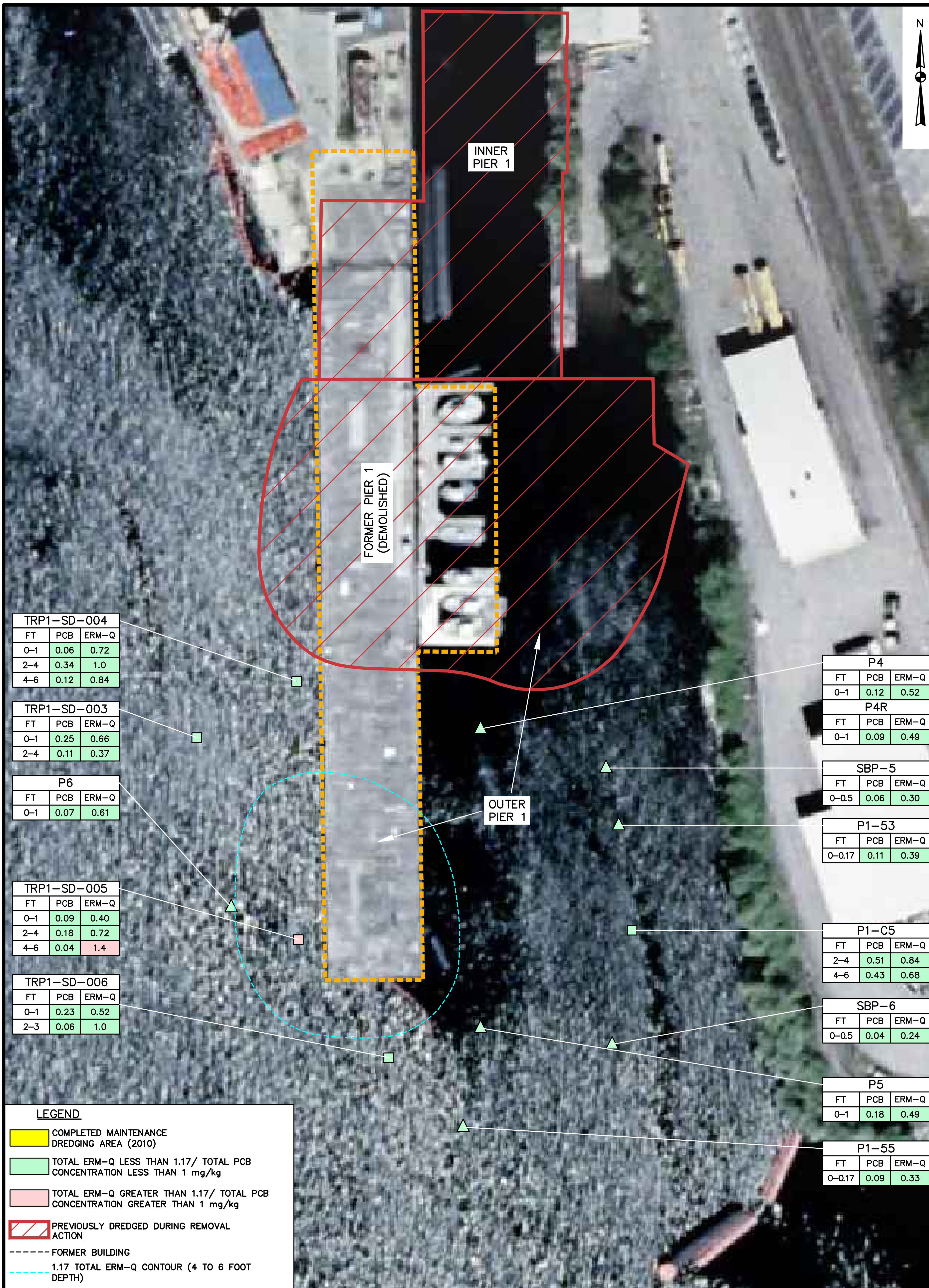
NSB-NLON
GROTON, CONNECTICUT

TOTAL ERM-Qs AND TOTAL PCB CONCENTRATIONS ZONE 4 SEDIMENTS LOWER SUBASE

SCALE: 1"=120'

DATE:	6/2/11
PROJECT NO.:	112G03512
DESIGNED BY:	
DRAWN BY:	CK
CHECKED BY:	CAR
SHEET:	1 OF 1

FIGURE 4-6



LEGEND

- COMPLETED MAINTENANCE DREDGING AREA (2010)
- TOTAL ERM-Q LESS THAN 1.17/ TOTAL PCB CONCENTRATION LESS THAN 1 mg/kg
- TOTAL ERM-Q GREATER THAN 1.17/ TOTAL PCB CONCENTRATION GREATER THAN 1 mg/kg
- PREVIOUSLY DREDGED DURING REMOVAL ACTION
- FORMER BUILDING
- 1.17 TOTAL ERM-Q CONTOUR (4 TO 6 FOOT DEPTH)
- SAMPLE LOCATION WITH TOTAL ERM-Q LESS THAN 1.17 AND TOTAL PCB CONCENTRATION LESS THEN 1 mg/kg
- SAMPLE LOCATION WITH TOTAL ERM-Q GREATER THAN 1.17 OR TOTAL PCB CONCENTRATION GREATER THEN 1 mg/kg
- ONLY SURFACE SAMPLE COLLECTED
- MULTIPLE DEPTHS COLLECTED

UNITS:

-DEPTH PRESENTED IN FEET
-ERM-Q VALUE IS UNITLESS
-PCB CONCENTRATION PRESENTED IN MG/KG

0 50 100
SCALE: 1" = 50'

R:\3512\Figures\3512FG008.dwg PIT NICHOLE.DILLA 11/8/2011 10:29:17 AM

TETRA TECH
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661 ANDERSEN DRIVE – FOSTER PLAZA 7
PITTSBURGH, PA 15220
T: (412) 921-7090 | F: (412) 921-4040

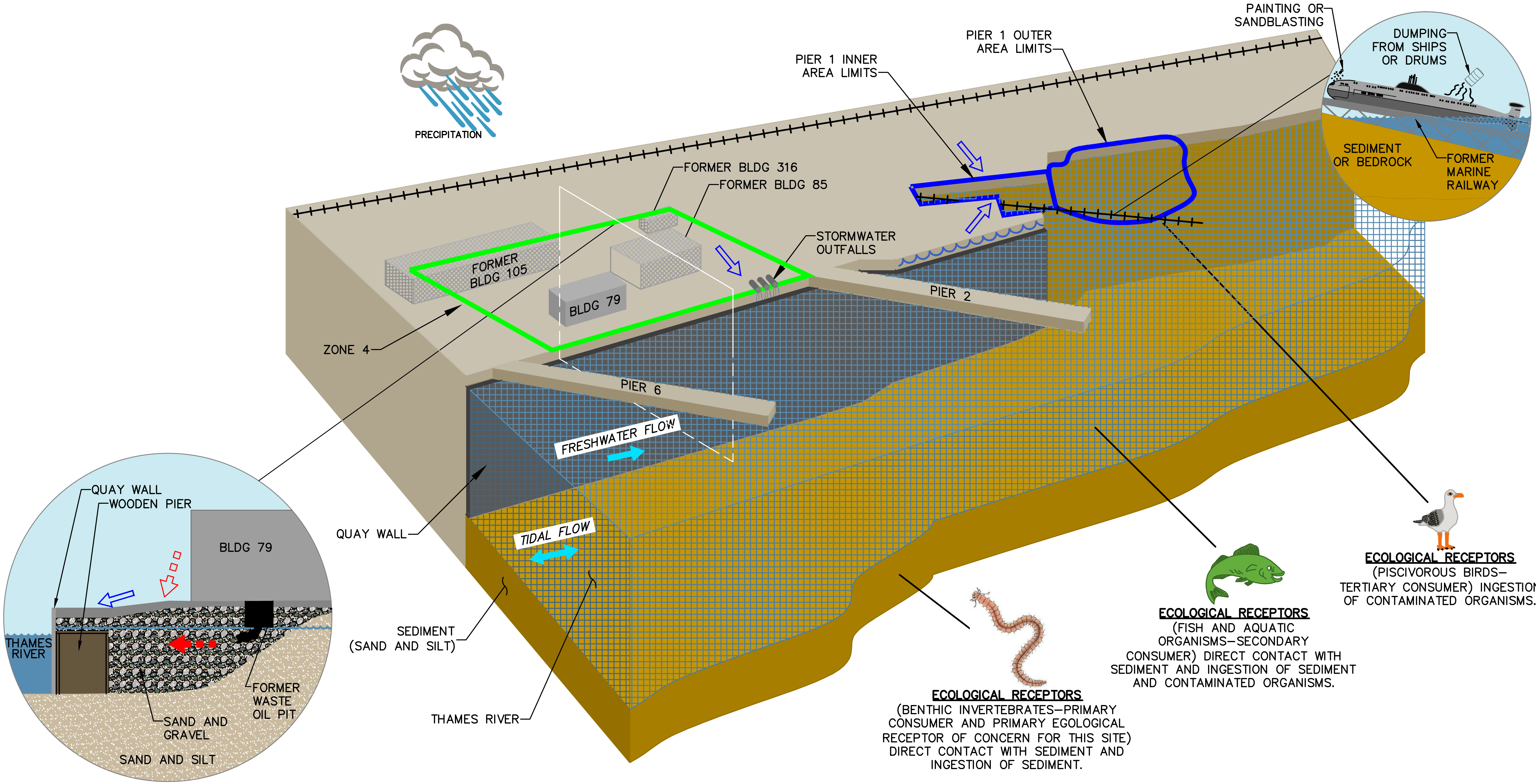
NSB-NLON
GROTON, CONNECTICUT

TOTAL ERM-Qs AND TOTAL PCB CONCENTRATIONS OUTER PIER 1 SEDIMENTS LOWER SUBASE

SCALE: 1"=120'

DATE:	11/4/11
PROJECT NO.:	112G03512
DESIGNED BY:	
DRAWN BY:	ND
CHECKED BY:	LG
SHEET: 1 OF 1	

FIGURE 4-7



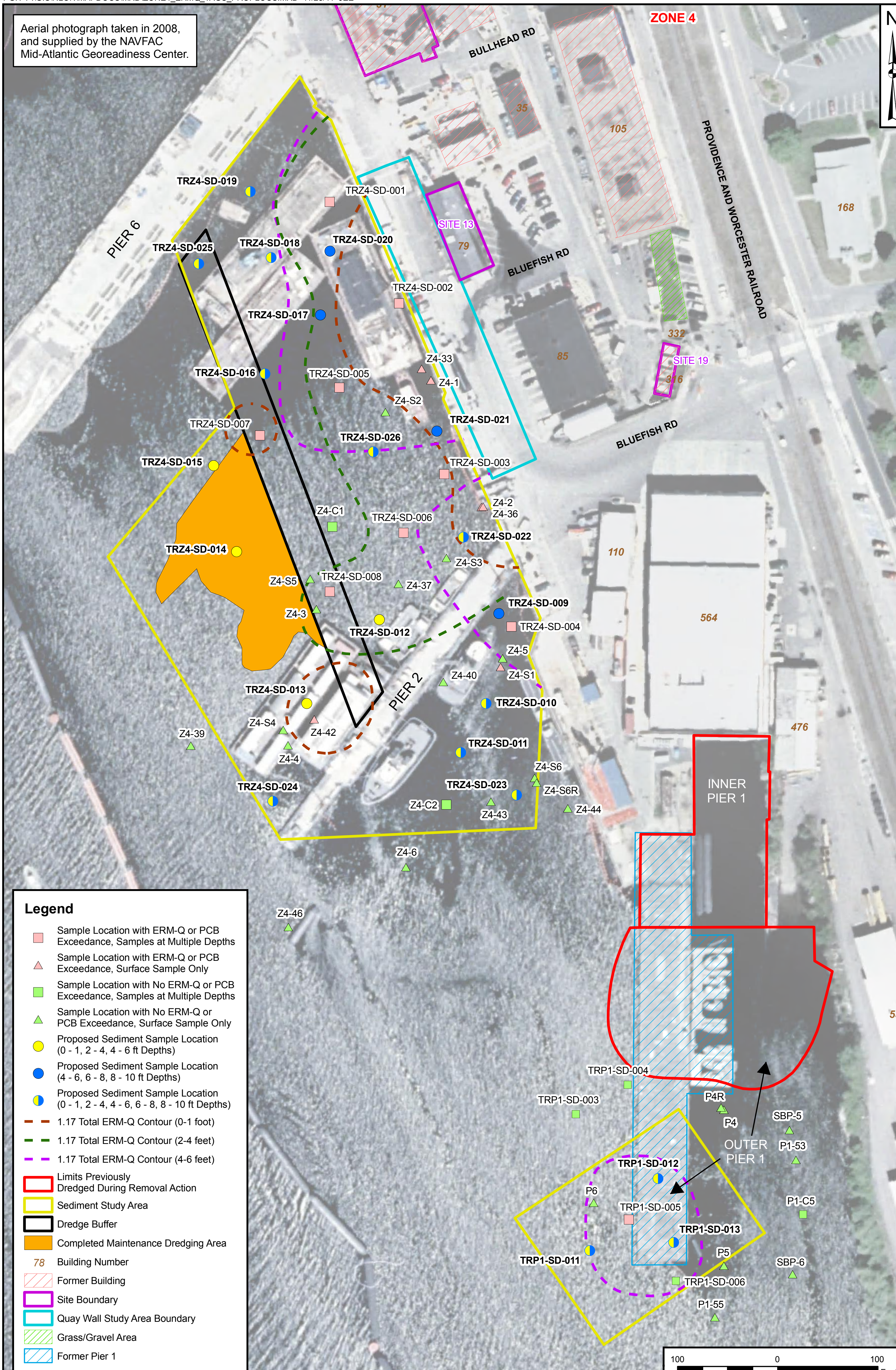
LEGEND
- TIDAL FLUCUATION
- WATER TABLE
- CONTAMINANT MIGRATION THROUGH GROUNDWATER FLOW
- INFILTRATION OF CONTAMINANTS FROM HISTORIC ZONES
- SURFACE RUNOFF
- RAILROAD TRACKS OR FORMER MARINE RAILWAY

TETRA TECH WWW.TETRATECH.COM 661 ANDERSEN DRIVE – FOSTER PLAZA 7 PITTSBURGH, PA 15220 T: (412) 921–7090 | F: (412) 921–4040	NSB–NLON GROTON, CONNECTICUT CONCEPTUAL SITE MODEL FOR ZONE 4 AND OUTER PIER 1 SEDIMENT SCALE: NOT TO SCALE	DATE: 6–22–11 PROJECT NO.: 112G03512 DESIGNED BY: LMG DRAWN BY: ND CHECKED BY: CAR SHEET: OF –––

FIGURE 4–8

R:\2195 – NSB New London\CSM\2195CSM12.dwg PIT NICHOLE.DILLA 10/28/2011 2:43:31 PM

PGH P:\GIS\NLON\MAPDOCS\MXD\ZONE4_ERMQ_TAGS_PROPLOCS.MXD 11/28/11 JEE



DRAWN BY J. ENGLISH	DATE 06/30/11	TETRA TECH	CONTRACT NUMBER 03512	CTO NUMBER WE34
CHECKED BY L. GANSER	DATE 11/28/11	PROPOSED SAMPLING LOCATIONS ZONE 4 AND OUTER PIER 1 SEDIMENTS NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT	APPROVED BY L. GANSER	DATE 11/28/11
REVISED BY J. ENGLISH	DATE 11/28/11		APPROVED BY —	DATE —
SCALE AS NOTED			FIGURE NO. FIGURE 5-1	REV 0

APPENDIX A

FIELD STANDARD OPERATING PROCEDURES

- **SA-6.1 – NON-RADIOLOGICAL SAMPLE HANDLING**
- **SA-1.2 – SURFACE WATER AND SEDIMENT SAMPLING**
- **SA-6.3 – FIELD DOCUMENTATION**
- **SA-7.1 – DECONTAMINATION OF FIELD EQUIPMENT**
- **CT-04 – SAMPLE NOMENCLATURE**
- **VIBRACORING PROCEDURE**

TETRA TECH	STANDARD OPERATING PROCEDURES	Number SA-6.1	Page 1 of 11
		Effective Date 01/2012	Revision 4
		Applicability Tetra Tech, Inc.	
		Prepared Earth Sciences Department	
Subject NON-RADIOLOGICAL SAMPLE HANDLING		Approved J. Zimmerly	

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SECTION **PAGE**

ATTACHMENTS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of ϶172.101 and ϶172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (¥261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (¥261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H_2SO_4
- Nitric Acid - HNO_3
- Sodium Hydroxide - NaOH

Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - $Na_2S_2O_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR ͽ172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

4.0 RESPONSIBILITIES

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

5.0 PROCEDURES

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

5.1 Sample Containers

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4EC. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO_3, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4EC, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TtNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H_2SO_4)	1 part concentrated H_2SO_4: 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO_3)	Undiluted concentrated HNO_3	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.
- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).
- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

  If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

  Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

  The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

  The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

  If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

  Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory <u>before</u> sampling begins.

5.3 <u>Field Filtration</u>

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed <u>prior to</u> the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.

- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

5.4 <u>Sample Packaging and Shipping</u>

Only employees who have successfully completed the TtNUS “Shipping Hazardous Materials” training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either <u>environmental</u> or <u>hazardous material samples</u>. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)

- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.

- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.

- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.

- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).

- Seal (i.e., tape or tie top in knot) large liner bag.

- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.

- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

ATTACHMENT A

GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration		Container[1]	Sample Size	Preservation[2]	Holding Time[2]
WATER					
Organics (GC&GC/MS)	VOC Low	Borosilicate glass	2 x 40 mL	Cool to 4EC HCl to # 2	14 days[9]
	Extractables (Low SVOCs and pesticide/PCBs)	Amber glass	2x2 L or 4x1 L	Cool to 4EC	7 days to extraction; 40 days after extraction
	Extractables (Medium SVOCs and pesticide/PCBs)	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals Low	High-density polyethylene	1 L	HNO_3 to pH #2	6 months (Hg-28 days)
	Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard	Wide-mouth glass	8 oz.	None	14 days
SOIL					
Organics (GC&GC/MS)	VOC	EnCore Sampler	(3) 5 g Samplers	Cool to 4EC	48 hours to lab preservation
	Extractables (Low SVOCs and pesticides/PCBs)	Wide-mouth glass	8 oz.	Cool to 4EC	14 days to extraction; 40 days after extraction
	Extractables (Medium SVOCs and pesticides/PCBs)	Wide-mouth glass	8 oz.	Cool to 4EC	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium	Wide-mouth glass	8 oz.	Cool to 4EC	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorganic	High Hazard	Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All	Wide-mouth glass	4 oz.	None	35 days until extraction; 40 days after extraction
TCLP	All	Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction
AIR					
Volatile Organics	Low/Medium	Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4EC	5 days recommended

1 All glass containers should have Teflon cap liners or septa.
2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

ATTACHMENT B

ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container(1)	Preservation(2)(3)	Maximum Holding Time(4)
INORGANIC TESTS:			
Acidity	P, G	Cool, 4EC	14 days
Alkalinity	P, G	Cool, 4EC	14 days
Ammonia - Nitrogen	P, G	Cool, 4EC; H_2SO_4 to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4EC	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4EC; H_2SO_4 to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4EC	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4EC; NaOH to pH 12; 0.6 g ascorbic acid(5)	14 days(6)
Fluoride	P	None required	28 days
Hardness	P, G	HNO_3 to pH 2; H_2SO_4 to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4EC; H_2SO_4 to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4EC; H_2SO_4 to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4EC	48 hours
Oil & Grease	G	Cool, 4EC; H_2SO_4 to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4EC; HCl or H_2SO_4 to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4EC	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4EC; H_2SO_4 to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4EC; H_2SO_4 to pH 2	28 days
Residue, Total	P, G	Cool, 4EC	7 days
Residue, Filterable (TDS)	P, G	Cool, 4EC	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4EC	7 days
Residue, Settleable	P, G	Cool, 4EC	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4EC	7 days
Silica	P	Cool, 4EC	28 days
Specific Conductance	P, G	Cool, 4EC	28 days
Sulfate	P, G	Cool, 4EC	28 days

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE TWO

Parameter Number/Name	Container[1]	Preservation[2][3]	Maximum Holding Time[4]
INORGANIC TESTS (Cont'd):			
Sulfide	P, G	Cool, 4EC; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4EC	48 hours
METALS:[7]			
Chromium VI (Hexachrome)	P, G	Cool, 4EC	24 hours
Mercury (Hg)	P, G	HNO_3 to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO_3 to pH 2	6 months
ORGANIC TESTS:[8]			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4EC; 0.008% $Na_2S_2O_3$[5]	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4EC; 0.008% $Na_2S_2O_3$[5] HCl to pH 2 [9]	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4EC; 0.008% $Na_2S_2O_3$[5] adjust pH to 4-5 [10]	14 days
Phenols[11]	G, Teflon-lined cap	Cool, 4EC; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Benzidines[11], [12]	G, Teflon-lined cap	Cool, 4EC; 0.008% $Na_2S_2O_3$[5]	7 days until extraction[13]
Phthalate esters[11]	G, Teflon-lined cap	Cool, 4EC	7 days until extraction; 40 days after extraction
Nitrosamines[11], [14]	G, Teflon-lined cap	Cool, 4EC; store in dark; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
PCBs[11]	G, Teflon-lined cap	Cool, 4EC	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone[11]	G, Teflon-lined cap	Cool, 4EC; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs)[11],[14]	G, Teflon-lined cap	Cool, 4EC; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Haloethers[11]	G, Teflon-lined cap	Cool, 4EC; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF)[11]	G, Teflon-lined cap	Cool, 4EC; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE THREE

(1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
(2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4EC until compositing and sample splitting is completed.
(3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
(4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
(5) Should only be used in the presence of residual chlorine.
(6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
(7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
(8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
(9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
(10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
(11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4EC, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
(12) If 1,2-diphenylthydrazine is likely to be present, adjust the pH of the sample to 4.0∀0.2 to prevent rearrangement to benzidine.
(13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
(14) For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.
(15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

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		Effective Date 01/2012	Revision 6
		Applicability Tetra Tech, Inc.	
		Prepared Earth Sciences Department	
Subject SURFACE WATER AND SEDIMENT SAMPLING		Approved J. Zimmerly	

TABLE OF CONTENTS

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures and equipment commonly used for collecting environmental samples of surface water and aquatic sediment for either onsite examination and chemical testing or for offsite laboratory analysis.

2.0 SCOPE

The information presented in this document is applicable to all environmental sampling of surface waters (Section 5.3) and aquatic sediments (Section 5.5), except where the analyte(s) may interact with the sampling equipment. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions, and equipment different from those described herein.

3.0 GLOSSARY

Analyte – Chemical or radiochemical material whose concentration, activity, or mass is measured.

Composite Sample – A sample representing a physical average of grab samples.

Environmental Sample – A quantity of material collected in support of an environmental investigation that does not require special handling or transport considerations as detailed in SOP SA-6.1.

Grab Sample – A portion of material collected to represent material or conditions present at a single unit of space and time.

Hazardous Waste Sample – A sample containing (or suspected to contain) concentrations of contaminants that are high enough to require special handling and/or transport considerations per SOP SA-6.1.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - The Project Manager is responsible for determining the sampling objectives, initial sampling locations, and field procedures used in the collection of soil samples. The Project Manager also has the overall responsibility for seeing that all surface water and sediment sampling activities are properly conducted by appropriately trained personnel in accordance with applicable planning documents.

Field Operations Leader - This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is responsible for finalizing the locations for collection of surface water and sediment samples. The FOL is ultimately responsible for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self acquisition or through the management of a field team of samplers.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP). This includes but is not be limited to performing air quality monitoring during sampling and boring and excavation activities, and ensuring that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO or SSO designee may also be required to advise the FOL on other safety-related matters regarding boring and sampling, such as mitigative measures to address potential hazards from hazardous objects or conditions.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP and other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, , container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Precautions to preserve the health and safety of field personnel implementing this SOP are distributed throughout. The following general hazards may also exist during field activities, and the means of avoiding them must be used to preserve the health and safety of field personnel:

Bridge/Boat Sampling – Potential hazards associated with this activity include:

- Traffic – one of the primary concerns as samplers move across a bridge because free space of travel is not often provided. Control measures should include:
  - When sampling from a bridge, if the samplers do not have at least 6 feet of free travel space or physical barriers separating them and the traffic patterns, the HASP will include a Traffic Control Plan.
  - The use of warning signs and high-visibility vests are required to warn oncoming traffic and to increase the visibility of sample personnel.
- Slips, trips, and falls from elevated surfaces are a primary concern. Fall protection shall be worn when or if samplers must lean over a rail to obtain sample material. A Fall Protection Competent Person (in accordance with Occupational safety and Health Administration [OSHA] fall protection standards) must be assigned to ensure that fall protection is appropriately and effectively employed

- Water hazards/drowning – if someone enters the water from an elevated surface (such as a bridge or dock) and when sampling from a boat. To minimize this potential, personnel shall wear United states Coast Guard (USCG)-approved floatation devices, and the sampling crew must also have on hand a Type IV Throwable Personal Floatation Device with at least 90 feet of 3/8-inch rope. See Section 5.5.2 of this SOP.

- Within the HASP, provisions will also be provided concerning the requirement of a Safe Vessel Certification or the necessity to conduct a boat inspection prior to use. In addition, the HASP shall also specify requirements as to whether the operator must be certified as a commercial boat operator and whether members of the sampling team must have a state-specific safe boating certification.

Entering Water to Collect Samples – Several hazards are associated with this activity and can be mitigated as follows:

- Personnel must wear a USCG-approved Floatation Device (selected and identified in the HASP). The SSO shall ensure that the device selected is in acceptable condition and suitable for the individual using it. This includes consideration of the weight of the individual.

- Lifelines shall be employed from a point on the shore. This activity will always be conducted with a Buddy. See Section 6.5.2.

- Personnel shall carry a probe to monitor the bottom ahead of them for drop offs or other associated hazards.

- The person in the water shall exercise caution concerning the path traveled so that the lifeline does not become entangled in underwater obstructions such as logs, branches, stumps, etc., thereby restricting its effectiveness in extracting the person from the water.

- Personnel shall not enter waters on foot in situations where natural hazards including alligators, snakes, as well as sharks, gars, and other predators within inland waterways may exist.

- In all cases, working along and/or entering the water during high currents or flood conditions shall be prohibited.

- Personnel shall not enter bodies of water where known debris exists that could result in injuries from cuts and lacerations.

Sampling in marshes or tidal areas in some instances can be accomplished using an all-terrain vehicle (ATV). This is not the primary recommended approach because the vehicle may become disabled, or weather conditions or tidal changes could result in environmental damage as well as loss of the vehicle. The primary approach is recommended to be on foot where minimal disturbance would occur. The same precautions specified above with regard to sediment disturbance apply as well as the previously described safety concerns associated with natural hazards. The natural hazards include alligators, bees (nests in dead falls and tree trunks), snakes, etc. In addition, moving through and over this terrain is difficult and could result in muscle strain and slips, trips, and falls. Common sense dictates that the sampler selects the most open accessible route over moderate terrain. Move slowly and deliberately through challenging terrain to minimize falls. Mud boots or other supportive PPE should be considered and specified in the HASP to permit samplers to move over soft terrain with the least amount of effort. In these situations, it is also recommended, as the terrain allows, that supplies be loaded and transported in a sled over the soft ground.

Working in these areas, also recognize the following hazards and means of protection against them:

Insects are also a primary concern. These include mosquitoes, ticks, spiders, bees, ants, etc. The HASP will identify those particular to your area. Typical preventative measures include:

- Use insect repellant. Approval of various repellants should be approved by the Project Chemist or Project Manager.
- Wearing light colored clothing to control heat load due to excessive temperatures. In addition, it makes it easier to detect crawling insects on your clothing.
- Taping pants to boots to deny access. Again, this is recommended to control access to the skin by crawling insects. Consultation with the Project Health and Safety Officer SSO/Health and Safety Manager is recommended under extreme heat loads because this will create conditions of heat stress.
- Performing a body check to remove insects. The quicker you remove ticks, the less likely they will become attached and transfer bacteria to your bloodstream. Have your Buddy check areas inaccessible to yourself. This includes areas such as the upper back and between shoulder blades where it is difficult for you to examine and even more difficult for you to remove.

Safety Reminder

If you are allergic to bee or ant stings, it is especially critical that you carry your doctor-recommended antidote with you in these remote sampling locations due to the extended time required to extract incapacitated individuals as well as the effort required to extract them. In these scenarios, instruct your Buddy in the proper administration of the antidote. In all cases, if you have received a sting, administer the antidote regardless of the immediate reaction, evacuate, and seek medical attention as necessary. The FOL and/or SSO will determine when and if you may return to the field based on the extent of the immune response and hazards or potential hazards identified in these locations. To the FOL and SSO, this is a serious decision you have to make as to whether to take someone vulnerable to these hazards into a remote location where you may not be able to carry them out. Consider it wisely.

Poisonous Plants – To minimize the potential of encountering poisonous plants in the field, at least one member of the field team needs to have basic knowledge of what these plants look like so that they can be recognized, pointed out to other field personnel, and avoided if at all possible. If the field team cannot avoid contact and must move through an area where these plants exist, the level of personal protective equipment (PPE) shall include Tyvek coveralls and enhanced decontamination procedures for the removal of oils from the tooling and/or equipment.

Temperature-Related Stress – Excessively cold temperatures may result in cold stress, especially when entering the water either intentionally or by accident. Provisions for combating this hazard should be maintained at the sample location during this activity. Excessively hot temperatures may result in heat stress especially in scenarios where equipment is packed through the marsh.

Because all of these activities are conducted outside, electrical storms are a significant concern. The following measures will be incorporated to minimize this hazard:

- Where possible, utilize commercial warning systems and weather alerts to detect storms moving into the area.

- If on or in the water, get out of the water. Move to vehicles or preferably into enclosed buildings with plumbing and wiring.
- Where warning systems are not available, follow the 30/30 Rule (*if there are less than 30 seconds between thunder and lightning, go inside for at least 30 minutes after the last thunder).*

See Section 4.0 of the Health and Safety Guidance Manual (HSGM) for additional protective measures.

6.0 PROCEDURES

6.1 Introduction

Collecting a representative sample of surface water or sediment may be difficult because of water movement, stratification, or heterogeneous distribution of the targeted analytes. To collect representative samples, one must standardize sampling methods related to site selection, sampling frequency, sample collection, sampling devices, and sample handling, preservation, and identification. Regardless of quality control applied during laboratory analyses and subsequent scrutiny of analytical data packages, reported data are no better than the confidence that can be placed in the representativeness of the samples. Consult Appendix C for guidance on sampling that should be considered during project planning and that may be helpful to field personnel.

6.1.1 Surface Water Sampling Equipment

The selection of sampling equipment depends on the site conditions and sample type to be acquired. In general, the most representative samples are obtained from mid-channel at a stream depth of 0.5 foot in a well-mixed stream; however, project-specific planning documents will address site-specific sampling requirements including sample collection points and sampling equipment. The most frequently used samplers include the following:

- Peristaltic pump
- Bailer
- Dip sampler
- Weighted bottle
- Hand pump
- Kemmerer
- Depth-integrating sampler

The dip sampler and weighted bottle sampler are used most often, and detailed discussions for these devices and the Kemmerer sampler are addressed subsequently in this section.

The criteria for selecting a sampler include:

1. Disposability and/or easy decontamination.
2. Inexpensive cost (if the item is to be disposed).
3. Ease of operation.
4. Non-reactive/non-contaminating properties - Teflon-coated, glass, stainless-steel or polyvinyl chloride (PVC) sample chambers are preferred (in that order).

Measurements collected for each sample (grab or each aliquot collected for compositing) shall include but not be limited to:

- Specific conductance
- Temperature
- pH
- Dissolved oxygen

Sample measurements shall be conducted as soon as the sample is acquired. Measurement techniques described in SOP SA-1.1 shall be followed. All pertinent data and results shall be recorded in a field notebook or on sample log sheets (see Attachment A) or an equivalent electronic form(s). These analyses may be selected to provide information on water mixing/stratification and potential contamination. Various types of water bodies have differing potentials for mixing and stratification.

In general, the following equipment if necessary for obtaining surface water samples:

- Required sampling equipment, which may include a remote sampling pole, weighted bottle sampler, Kemmerer sampler, or other device.

- Real-time air monitoring instrument (e.g., PID, FID) as directed in the project-specific planning document.

- Required PPE as directed in the project-specific planning document, which may include:

  - Nitrile surgeon's or latex gloves (layered as necessary).

  - Safety glasses.

  - Other items identified on the Safe Work Permit that may be required based on location-specific requirements (e.g., hearing protection, steel-toed work boots, hard hat). These provisions will be listed in the HASP or addressed by the FOL and/or SSO.

> ***Safety Reminder***
> The use of latex products may elicit an allergic reaction in some people. Should this occur, remove the latex gloves, treat for an allergic reaction, and seek medical attention as necessary.

  - Required paperwork (see SOP SA-6.3 and Attachments A and B to this SOP).

  - Required decontamination equipment.

  - Required sample containers.

  - Sealable polyethylene bags (e.g., Ziploc® baggies).

  - Heavy-duty cooler.

  - Ice.

  - Paper towels and garbage bags.

  - Chain-of-custody records and custody seals.

Dip Sampling

Specific procedures for collecting a dip or grab sample of surface water can vary based on site-specific conditions (e.g., conditions near the shore and how closely a sampler can safely get to the shore). The general procedure for collecting a sample using a pole or directly from the water body is as follows:

1. If using a remote sampling pole, securely attach the appropriate sample container to a pole of sufficient length to reach the water to be sampled. Samples for volatile analysis should be collected first. Use PPE as described in the HASP. When sample containers are provided pre-preserved or if the pole cannot accommodate a particular sample container, use a dedicated, clean, unpreserved bottle/container for sampling and transfer to an appropriately preserved container.

2. Remove the cap. Do not place the cap on the ground or elsewhere where it might become contaminated.

3. Carefully dip the container into the water just below the surface (or as directed by project-specific planning documents), and allow the bottle to fill. Sample bottles for volatile analysis must be filled with no headspace. Avoid contacting the bottom of the water body because this will disturb sediment that may interfere with the surface water sample.

4. Retrieve the container and carefully replace the cap securely. If using a container other than the sample bottle, pour the water from that container into the sample bottle and replace the cap securely.

5. Use a clean paper towel to clean and dry the outside of the container.

6. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.

7. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

Constituents measured in grab samples collected near the water surface are only indicative of conditions near the surface of the water and may not be a true representation of the total concentration distributed throughout the water column and in the cross section. Therefore, as possible based on site conditions, the sampler may be required to augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

CAUTION

In areas prone to natural hazards such as alligators and snakes, etc., always use a buddy as a watch. Always have and use a lifeline or throwable device to extract persons who could potentially fall into the water. Be attentive to the signs, possible mounds indicating nests, and possible slides into the water. Remember that although snakes are typically encountered on the ground, it is not unheard of to see them on low-hanging branches. Be attentive to your surroundings because these may indicate that hazards are nearby.

Weighted Bottle Sampling

A grab sample can also be collected using a weighted holder that allows a bottle to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects sample throughout the total depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach what is known as a depth-integrated sample.

A closed weighted bottle sampler consists of glass or plastic bottle with a stopper, a weight and/or holding device, and lines to open the stopper and lower or raise the bottle. The general procedure for sampling with this device is as follows:

1. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).

2. When the desired depth is reached, pull out the stopper with a sharp jerk of the stopper line.

3. Allow the bottle to fill completely, as evidenced by the absence of air bubbles.

4. Raise the sampler and cap the bottle.

5. Use a paper towel to clean and dry the outside of the container. This bottle can be used as the sample container as long as the bottle is an approved container type.

6. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.

7. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

Kemmerer Sampler

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon-coated sampler, a standard Kemmerer sampler may be used. The Kemmerer sampler is a brass, stainless steel or acrylic cylinder with rubber stoppers that leave the ends open while it is lowered in a vertical position (thus allowing free passage of water through the cylinder). A "messenger" is sent down the line when the sampler is at the designated depth to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill sample bottles. The general procedure for sampling with this device is as follows:

1. Gently lower the sampler to the desired depth.

2. When the desired depth is reached, send down the messenger to close the cylinder and then raise the sampler.

3. Open the sampler valve to fill each sample bottle (filling bottles for volatile analysis first).

4. Use a paper towel to clean and dry the outside of the container.

5. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.

6. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

6.1.2 Surface Water Sampling Techniques

Samples collected during site investigations may be grab samples or composite samples. The following general procedures apply to various types of surface water collection techniques:

- If a clean, pre-preserved sample container is not used, rinse the sample container least once with the water to be sampled before the sample is collected. This is not applicable when sample containers are provided pre-preserved because doing so will wash some or all of the preservative out of the bottle.

- For sampling moving water, collect the farthest downstream sample first, and continue sample collection in an upstream direction. In general, work from zones suspected of low contamination to zones of high contamination.

- Take care to avoid excessive agitation of the water because loss of volatile constituents could result.

- When obtaining samples in 40 mL vials with septum-lined lids for volatile organics analysis, fill the container completely (with a meniscus) to exclude any air space in the top of the bottle and to be sure that the Teflon liner of the septum faces in after the vial is filled and capped. Turn the vial upside down and tap gently on your wrist to check for air bubbles. If air bubbles rise in the bottle, add additional sample volume to the container.

- Do not sample at the surface, unless sampling specifically for a known constituent that is immiscible and on top of the water. Instead, invert the sample container, lower it to the approximate depth, and hold it at about a 45-degree angle with the mouth of the bottle facing upstream.

6.2 Onsite Water Quality Testing

Onsite water quality testing shall be conducted as described in SOP SA-1.1.

6.3 Sediment Sampling

6.3.1 General

If composite surface water samples are collected, sediment samples are usually collected at the same locations as the associated surface water samples. If only one sediment sample is to be collected, the sampling location shall be approximately at the center of the water body, in a depositional area if possible based on sample location restraints (see below), unless the SAP states otherwise.

Generally, coarser-grained sediments are deposited near the headwaters of reservoirs. Bed sediments near the center of a water body will be composed of fine-grained materials that may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations of contaminants. The shape, flow pattern, bathymetry (i.e., depth distribution), and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (e.g., bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) shall be sampled, in general, and areas likely to show net erosion (i.e., high-velocity, turbulent areas) and suspension of fine solid materials shall be generally avoided. Follow instructions in the SAP, as applicable.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments (especially fine-grained material) may act as a sink or reservoir for adsorbed heavy metals and organic contaminants (even if water column concentrations are less than detection limits). Therefore, it is important to minimize the loss of low-density "fines" during any sampling process.

Samples collected for volatile organic compound (VOC) analysis must be collected prior to any sample homogenization. Regardless of the method used for collection, the aliquot for VOC analysis must be collected directly from the sampling device (hand auger bucket, scoop, trowel), to the extent practical. If a device such as a dredge is used, the aliquot should be collected after the sample is placed in the mixing container prior to mixing.

In some cases, the sediment may be soft and not lend itself to collection by plunging Encore™ or syringe samplers into the sample matrix. In these cases, it is appropriate to open the sampling device, (Encore™ barrel or syringe) prior to sample collection, and carefully place the sediment in the device, filling it fully with the required volume of sample.

On active or former military sites, ordnance items may be encountered in some work areas. Care should be exercised when handling site media (such as if unloading a dredge as these materials may be scooped up). If suspected ordnance items are encountered, stop work immediately, move to shore and notify the Project Manager and Health and Safety Manager.

All relevant information pertaining to sediment sampling shall be documented as applicably described in SOP SA-6.3 and Attachment B or an equivalent electronic form.

6.3.2 Sampling Equipment and Techniques for Bottom Materials

A bottom-material sample may consist of a single scoop or core, or may be a composite of several individual samples in the cross section. Sediment samples may be obtained using onshore or offshore techniques.

> ***SAFETY REMINDER***
>
> The following health and safety provisions apply when working on/over/near water:
>
> - At least two people are required to be present at the sampling location in situations where the water depth and/or movement deem it necessary, each wearing a USCG-approved Personal Flotation Devices
>
> - A minimum of three people are required if *any* of the following conditions are anticipated or observed:
>
>   - Work in a waterway that is turbulent *or* swift that could sweep a sampler down stream should he or she fall in accidentally.
>
>   - The underwater walking surface (e.g., stream/river bed) is suspected or observed to involve conditions that increase the potential for a worker to fall into the water. Examples include large/uneven rocks or boulders, dense mud or sediment that could entrap worker's feet, etc.
>
>   - Waterway is tidal, and conditions such as those listed above could rapidly change.
>
> The third person in the above condition must be equipped and prepared to render emergency support [e.g., lifeline, tethered Personal Flotation Device (Throwable Type IV, life saver), skiff, means to contact external emergency response support, etc.]

The following samplers may be used to collect sediment samples:

- Scoop sampler
- Dredge samplers
- Coring samplers

Each type of sampler is discussed below.

In general, the following equipment if necessary for obtaining sediment samples:

- Required sampling equipment, which may include a scoop sampler, dredge sampler, coring sampler, or stainless steel or pre-cleaned disposable trowel.

- Stainless bowl or pre-cleaned disposable bowl to homogenize sample.

- Real-time air monitoring instrument (e.g., PID, FID) as directed in the project-specific planning document.

- Required PPE as directed in the project-specific planning document, which may include:

  - Nitrile surgeon's or latex gloves (layered as necessary).

  - Safety glasses.

  - Other items identified on the Safe Work Permit that may be required based on location-specific requirements (e.g., hearing protection, steel-toed work boots, hard hat). These provisions will be listed in the HASP or addressed by the FOL and/or SSO.

  - Required paperwork (see SOP SA-6.3 and Attachments A and B to this SOP).

  - Required decontamination equipment.

  - Required sample containers.

  - Sealable polyethylene bags (e.g., Ziploc® baggies).

  - Heavy-duty cooler.

  - Ice.

  - Paper towels and garbage bags.

  - Chain-of-custody records and custody seals.

<u>Scoop Sampler</u>

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood, PVC, or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if the sampler can safely wade to the required location, the easiest and best way to collect a sediment sample is to use a scoop sampler. Scoop sampling also reduces the potential for cross-contamination. The general scoop sampling procedure is as follows:

1. Reach over or wade into the water body.

2. While facing upstream (into the current), scoop the sampler along the bottom in an upstream direction. Although it is very difficult not to disturb fine-grained materials at the sediment-water interface when using this method, try to keep disturbances to a minimum.

Dredge Samplers

Dredges are generally used to sample sediments that cannot easily be obtained using coring devices (e.g., coarse-grained or partially cemented materials) or when large quantities of sample are required. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a "messenger." Some dredges are heavy and may require use of a winch and crane assembly for sample retrieval. The three major types of dredges are Peterson, Eckman and Ponar.

The Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The Peterson dredge shall be lowered very slowly as it approaches bottom, because it can force out and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high flow velocities.

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends, thus reducing the "shock wave." The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

The general procedure for using dredge samplers is as follows:

1. Gently lower the dredge to the desired depth.

2. When the desired depth is reached, send the messenger down the cable to close the cylinder and then carefully raise the sampler.

3. Open the sampler to retrieve the sediment.

4. Transfer the sediment to the bowl in which it will be homogenized. Fill the sample bottle(s) for volatile analysis *prior to* homogenization. Homogenize the remainder of the sediment collected.

5. Fill the containers for all analyses other and VOCs.

6. Use a paper towel to clean and dry the outside of each container.

7. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.

~~8. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.~~

~~**SAFETY REMINDER**~~
~~Safety concerns using these dredges include lifting hazards, pinches, and compressions (several pinch points exist within the jaws and levers). In all cases, handle the dredge by the rope to avoid capturing fingers/hands.~~

<u>Coring Samplers</u>

Coring samplers are used to sample vertical columns of sediment. Many types of coring devices have been developed depending on the depth of water from which the sample is to be obtained, the nature of the bottom material, and the length of core to be collected. They vary from hand-push tubes to electronic vibrational core tube drivers.

Coring devices are particularly useful in pollutant monitoring because turbulence created by descent through the water is minimal, thus the fines at the sediment-water interface are only minimally disturbed. The sample is withdrawn intact, permitting the removal of only those layers of interest.

In shallow, wadeable waters, the use of a core liner or tube manufactured of Teflon or plastic is recommended for the collection of sediment samples. Caution should be exercised not to disturb the bottom sediments when the sample is obtained by wading in shallow water. The general procedure to collecting a sediment sample with a core tube is as follows:

1. Push the tube into the substrate until 4 inches or less of the tube is above the sediment-water interface. When sampling hard or coarse substrates, a gentle rotation of the tube while it is being pushed will facilitate greater penetration and decrease core compaction.

2. Cop the top of the tube to provide suction and reduce the chance of losing the sample.

3. Slowly extract the tube so as not to lose sediment from the bottom of the tube. Cap the bottom of the tube before removing it from the water. This will also help to minimize loss of sample.

4. Transfer the sediment to the bowl in which it will be homogenized. Fill the sample bottle(s) for volatile analysis prior to homogenization. Homogenize the remainder of the sediment collected.

5. Fill the containers for all analyses other and VOCs.

6. Use a paper towel to clean and dry the outside of each container.

7. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.

8. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

In deeper, non-wadeable water bodies, sediment cores may be collected from a bridge or boat using different coring devices such as Ogeechee Sand Pounders, gravity cores, and vibrating coring devices. All three devices utilize a core barrel with a core liner tube system. The core liners can be removed from the core barrel and replaced with a clean core liner after each sample. Before extracting the sediment from the coring tubes, the clear supernatant above the sediment-water interface in the core should be decanted from the tube. This is accomplished by turning the core tube to its side and gently pouring the liquid out until fine sediment particles appear in the waste liquid. Post-retrieval processing of samples is the same as above.

7.0 REFERENCES

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ATTACHMENT A
SURFACE WATER SAMPLE LOG SHEET

Tetra Tech

SURFACE WATER SAMPLE LOG SHEET

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Project Site Name: ____________________
Project No.: ____________________

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: ____________________
[] QA Sample Type: ____________________

Sample ID No.: ____________
Sample Location: ____________
Sampled By: ____________
C.O.C. No.: ____________

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT B
SOIL & SEDIMENT SAMPLE LOG SHEET

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: ____________________
Project No.: ____________________

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: ____________________
[] QA Sample Type: ____________________

Sample ID No.: ____________
Sample Location: ____________
Sampled By: ____________
C.O.C. No.: ____________

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

APPENDIX C
GUIDANCE ON SAMPLING DESIGN AND SAMPLE COLLECTION

C.1 Defining the Sampling Program

Many factors are considered in developing a sampling program for surface water and/or sediment, including study objectives, accessibility, site topography, physical characteristics of the water body (e.g., flow and mixing), point and diffuse sources of contamination, and personnel and equipment available to conduct the study. For waterborne constituents, dispersion depends on vertical and lateral mixing within the body of water. For sediment, dispersion depends on bottom current or flow characteristics, sediment characteristics (e.g., density, size), and geochemical properties (that affect adsorption/desorption). The hydrogeologist developing the sampling plan must therefore know not only the mixing characteristics of streams and lakes but must also understand the role of fluvial-sediment transport, deposition, and chemical sorption.

C.1.1 Sampling Program Objectives

The scope of the sampling program must consider the sources and potential pathways for transport of contamination to or within a surface water body. Sources may include point sources (leaky tanks, outfalls, etc.) or nonpoint sources (e.g., contaminated runoff). The major pathways for surface water contamination (not including airborne deposition) are overland runoff, leachate influx to the water body, direct waste disposal (solid or liquid) into the water body, and groundwater flow influx from upgradient. The relative importance of these pathways, and therefore the design of the sampling program, is controlled by the physiographic and hydrologic features of the site, the drainage basin(s) that encompasses the site, and the history of site activities.

Physiographic and hydrologic features to be considered include slopes and runoff direction, areas of temporary flooding or pooling, tidal effects, artificial surface runoff controls such as berms or drainage ditches (and when they were constructed relative to site operation), and locations of springs, seeps, marshes, etc. In addition, the obvious considerations such as the locations of man-made discharge points to the nearest stream (intermittent or flowing), pond, lake, estuary, etc. shall be considered.

A more subtle consideration in designing the sampling program is the potential for dispersion of dissolved or sediment-associated contaminants away from the source. The dispersion could lead to a more homogeneous distribution of contamination at low or possibly non-detectable concentrations. Such dispersion does not, however, always readily occur. For example, obtaining a representative sample of contamination from a main stream immediately below an outfall or a tributary is difficult because the inflow frequently follows a stream bank with little lateral mixing for some distance. Sampling alternatives to overcome this situation include: (1) moving the sampling location far enough downstream to allow for adequate mixing, or (2) collecting integrated samples in a cross section. Also, non-homogeneous distribution is a particular problem with regard to sediment-associated contaminants, which may accumulate in low-energy environments (coves, river bends, deep spots, or even behind boulders) near or distant from the source while higher-energy areas (main stream channels) near the source may show no contaminant accumulation.

The distribution of particulates within a sample itself is an important consideration. Many organic compounds are only slightly water soluble and tend to adsorb onto particulate matter. Nitrogen, phosphorus, and heavy metals may also be transported by particulates. Samples must be collected with a representative amount of suspended material; transfer from the sampling device shall include transferring a proportionate amount of the suspended material.

C.1.2 Location of Sampling Stations

Accessibility is the primary factor affecting sampling costs. The desirability and utility of a sample for analysis and consideration of site conditions must be balanced against the costs of collection as controlled by accessibility. Bridges or piers are the first choice for locating a sampling station on a stream because bridges provide ready access and also permit the sampling technician to sample any point across the stream. A boat or pontoon (with an associated increase in cost) may be needed to sample locations on lakes, reservoirs, or larger rivers. Frequently, however, a boat will take longer to cross a water body and will hinder manipulation of the sampling equipment. Wading for samples is not recommended unless it is known that contaminant levels are low so that skin contact will not produce adverse health effects. This provides a built in margin of safety in the event that wading boots or other protective equipment should fail to function properly. If it is necessary to wade into the water body to obtain a sample, the sampler shall be careful to minimize disturbance of bottom sediments and must enter the water body downstream of the sampling location. If necessary, the sampling technician shall wait for the sediments to settle before taking a sample.

Under ideal and uniform contaminant dispersion conditions in a flowing stream, the same concentrations of each contaminant would occur at all points along the cross section. This situation is most likely downstream of areas of high turbulence. Careful site selection is needed to ensure, as nearly as possible, that samples are taken where uniform flow or deposition and good mixing conditions exist.

The availability of stream flow and sediment discharge records can be an important consideration in choosing sampling sites in streams. Stream flow data in association with contaminant concentration data are essential for estimating the total contaminant loads carried by the stream. If a gaging station is not conveniently located on a selected stream, the project hydrogeologist shall explore the possibility of obtaining stream flow data by direct or indirect methods. Remember these locations are also where you may encounter natural hazards as these are areas where they hunt. Always exercise extreme caution.

C.1.3 Frequency of Sampling

The sampling frequency and objectives of the sampling event will be defined by the project planning documents. For single-event site or area characterization sampling, both bottom material and overlying water samples shall be collected at the specified sampling stations. If valid data are available on the distribution of a contaminant between the solid and aqueous phases, it may be appropriate to sample only one phase, although this is not often recommended. If samples are collected primarily for monitoring purposes (i.e., consisting of repetitive, continuing measurements to define variations and trends at a given location), water samples should be collected at a pre-established and constant interval as specified in the project plans (often monthly or quarterly and during droughts and floods). Samples of bottom material should generally be collected from fresh deposits at least yearly, and preferably seasonally, during both spring and fall.

The variability in available water quality data shall be evaluated before determining the number and collection frequency of samples required to maintain an effective monitoring program.

C.2 Surface Water Sample Collection

C.2.1 Streams, Rivers, Outfalls and Drainage Features

Methods for sampling streams, rivers, outfalls, and drainage features (ditches, culverts) at a single point vary from the simplest of hand-sampling procedures to the more sophisticated multi-point sampling techniques known as the equal-width-increment (EWI) method or the equal-discharge-increment (EDI) methods (see below).

Samples from different depths or cross-sectional locations in the watercourse taken during the same sampling episode shall be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore shall not be composited. Generally, the number and type of samples to be taken depend on the river's width, depth, and discharge and on the suspended sediment the stream or river transports. The greater the number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

In small streams less than about 20 feet wide, a sampling site can generally be found where the water is well mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross section.

For larger streams, at least one vertical composite shall be taken with one sample each from just below the surface, at mid-depth, and just above the bottom. The measurement of dissolved oxygen (DO), pH, temperature, conductivity, etc. shall be made on each aliquot of the vertical composite and on the composite itself. For rivers, several vertical composites shall be collected, as directed in the project planning documents.

C.2.2 Lakes, Ponds and Reservoirs

Lakes, ponds, and reservoirs have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained. The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small lakes, a single vertical composite at the deepest point may be sufficient. Similarly, measurement of DO, pH, temperature, etc. is to be conducted on each aliquot of the vertical composite and on the composite itself. In naturally formed ponds, the deepest point may have to be determined empirically; in impoundments, the deepest point is usually near the dam.

In lakes and larger reservoirs, several vertical composites shall be composited to form a single sample if a sample representative of the water column is required. These vertical composites are often collected along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones. In a stratified lake, the epilimnion is the thermocline that is exposed to the atmosphere. The hypolimnion is the lower, "confined" layer that is only mixed with the epilimnion and vented to the atmosphere during seasonal "overturn" (when density stratification disappears). These two zones may thus have very different concentrations of contaminants if input is only to one zone, if the contaminants are volatile (and therefore vented from the epilimnion but not the hypolimnion), or if the epilimnion only is involved in short-term flushing (i.e., inflow from or outflow to shallow streams). Normally, however, a composite consists of several vertical composites with samples collected at various depths.

In lakes with irregular shape and with bays and coves that are protected from the wind, separate composite samples may be needed to adequately represent water quality because it is likely that only poor mixing will occur. Similarly, additional samples are recommended where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

Many lake measurements are now made in situ using sensors and automatic readout or recording devices. Single and multi-parameter instruments are available for measuring temperature, depth, pH, oxidation-reduction potential (ORP), specific conductance, DO, some cations and anions, and light penetration.

6.2.3 Estuaries

Estuarine areas are, by definition, zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Knowledge of the estuary type may be necessary to determine sampling locations. Estuaries are generally categorized into one of the following three types dependent on freshwater inflow and mixing properties:

- Mixed Estuary - characterized by the absence of a vertical halocline (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically, this type of estuary is shallow and is found in major freshwater sheet flow areas. Because this type of estuary is well mixed, sampling locations are not critical.

- Salt Wedge Estuary - characterized by a sharp vertical increase in salinity and stratified freshwater flow along the surface. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally back and forth with the tidal phase. If contamination is being introduced into the estuary from upstream, water sampling from the salt wedge may miss it entirely.

- Oceanic Estuary - characterized by salinities approaching full strength oceanic waters. Seasonally, freshwater inflow is small, with the preponderance of the fresh-saline water mixing occurring near or at the shore line.

Sampling in estuarine areas is normally based on the tidal phase, with samples collected on successive slack tides (i.e., when the tide turns). Estuarine sampling programs shall include vertical salinity measurements at 1- to 5-foot increments, coupled with vertical DO and temperature profiles.

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		Applicability Tetra Tech, Inc.	
		Prepared Earth Sciences Department	
Subject FIELD DOCUMENTATION		Approved J. Zimmerly	

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ATTACHMENTS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs, and reports generally initiated and maintained for documenting Tetra Tech NUS, Inc. (TtNUS) field activities.

2.0 SCOPE

Documents presented within this SOP (or equivalents) shall be used for all TtNUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager (PM) - The PM is responsible for obtaining hardbound controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The FOL is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports included in this SOP (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time frame.

General personnel qualifications for field documentation activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for documentation, handling, packaging, and shipping.

5.0 PROCEDURES

5.1 SITE LOGBOOK

5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, record or reference the following activities/events (daily) in the site logbook:

- All field personnel present
- Arrival/departure times and names of site visitors
- Times and dates of health and safety training
- Arrival/departure times of equipment
- Times and dates of equipment calibration

- Start and/or completion of borehole, trench, monitoring well installation activities, etc.
- Daily on-site activities
- Sample pickup information
- Health and safety issues (level of protection, personal protective equipment [PPE], etc.)
- Weather conditions

Maintain a site logbook for each project and initiate it at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Make entries every day that on-site activities take place involving TtNUS or subcontractor personnel. Upon completion of the fieldwork, provide the site logbook to the PM or designee for inclusion in the project's central file.

Record the following information on the cover of each site logbook:

- Project name
- TtNUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2) but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, either record the measurements and equipment used in the site logbook or reference the field notebook in which the measurements are recorded (see Attachment A).

Make all logbook, notebook, and log sheet entries in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, cross out the entry with a single strike mark, initial, and date it. At the completion of entries by any individual, the logbook pages used must be signed and dated by the person making the entries. The site logbook must also be signed by the FOL at the end of each day.

5.1.2 Photographs

Sequentially number movies, slides, or photographs taken of a site or any monitoring location to correspond to logbook/notebook entries. Enter the name of the photographer, date, time, site location, site description, and weather conditions in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided because they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend on the subject matter, type of camera (digital or film), and the processing it requires. Follow chain-of-custody procedures for film used for aerial photography, confidential information, or criminal investigation. After processed, consecutively number the slides of photographic prints and label them according to the logbook/notebook descriptions. Docket the site photographs and associated negatives and/or digitally saved images to compact disks into the project's central file.

5.2 FIELD NOTEBOOKS

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

5.3 FIELD FORMS

All TtNUS field forms (see list in Section 6.0 of this SOP) can be found on the company's intranet site (http://intranet.ttnus.com) under Field Log Sheets. Forms may be altered or revised for project-specific needs, subject to client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOPs.

5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

5.3.1.1 Sample Log Sheet

Sample log sheets are used to record specified types of data while sampling. The data recorded on these sheets are useful in describing the sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. Complete a sample log sheet for each sample obtained, including field quality control (QC) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B. Complete the required information on the adhesive labels and apply them to every sample container. Obtain sample labels from the appropriate program/project source, request that they be electronically generated in house, or request them the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record

The chain-of-custody record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used as follows for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site:

- Retain one carbonless copy of the completed chain-of custody form in the field.
- Send one copy is sent to the PM (or designee)
- Send the original to the laboratory with the associated samples. Place the original (top, signed copy) of the chain-of custody form inside a large Ziploc®-type bag taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one chain-of custody form, send the form with the cooler containing vials for volatile organic compound (VOC) analysis or the cooler with the air bill attached. Indicate on the air bill how many coolers are included with that shipment.

An example of a chain-of-custody form is provided as Attachment C. After the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed chain-of custody form (any discrepancies between the sample labels and chain-of custody form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the TtNUS PM). The chain-of custody form is signed and copied. The laboratory will retain the copy, and the original becomes part of the samples' corresponding analytical data package.

5.3.1.4 Chain-of-Custody Seal

Attachment D is an example of a custody seal. The custody seal is an adhesive-backed label that is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. Sign and date custody seals and affix them across the lid and body of each cooler (front and back) containing environmental samples (see SOP SA-6.1). Obtain custody seals from the laboratory (if available) or purchase them from a supplier.

5.3.1.5 Geochemical Parameters Log Sheets

Complete Field Analytical Log Sheets to record geochemical and/or natural attenuation field test results.

5.3.2 Hydrogeological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

Complete a Groundwater Level Measurement Sheet for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. Use a Pumping Test Data Sheet to facilitate this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be established in advance.

5.3.2.3 Packer Test Report Form

Complete a Packer Test Report Form for each well at which a packer test is conducted.

5.3.2.4 Boring Log

Complete a Summary Log of Boring, or Boring Log for each soil boring performed to document the materials encountered, operation and driving of casing, and locations/depths of samples collected. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a photoionization detector [PID] or flame ionization detector [FID]), enter these readings on the boring log at the appropriate depth. When they become available, enter the laboratory sample number, concentrations of key contaminants, or other pertinent information in the "Remarks" column. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

Complete a Monitoring Well Construction Details Form for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock, stick-up or flush mount), different forms are used.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible field geologist or sampling technician.

5.3.2.7 Miscellaneous Monitoring Well Forms

Miscellaneous monitoring well forms that may be required on a project-specific basis include the Monitoring Well Materials Certificate of Conformance and Monitoring Well Development Record. Use a Monitoring Well Materials Certificate of Conformance to document all materials utilized during each monitoring well installation. Use a Monitoring Well Development Record to document all well development activities.

5.3.2.8 Miscellaneous Field Forms – Quality Assurance and Checklists

Miscellaneous field forms/checklists forms that may be required on a project-specific basis include the following:

- Container Sample and Inspection Sheet – use this form when a container (drum, tank, etc.) is sampled and/or inspected.
- QA Sample Log Sheet – use this form when a QA sample such as an equipment rinsate blank, source blank, etc. is collected.
- Field Task Modification Request (FTMR) – use this form to document deviations from the project planning documents. The FOL is responsible for initiating the FTMRs. Maintain copies of all FTMRs with the on-site planning documents, and place originals in the final evidence file.
- Field Project Daily Activities Checklist and Field Project Pre-Mobilization Checklist – used these during both the planning and field effort to ensure that all necessary tasks are planned for and completed. These two forms are not requirements but are useful tools for most field work.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring, or test equipment is necessary to ensure the proper operation and response of the equipment, to document the accuracy, precision, or sensitivity of the measurements, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log, which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. Maintain an Equipment Calibration Log for each electronic measuring device used in the field; make entries for each day the equipment is used or in accordance with manufacturer recommendations.

5.4 <u>FIELD REPORTS</u>

The primary means of recording on-site activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation but are not easily used for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain on site for extended periods of time and are thus not accessible for timely review by project management. Other reports useful for tracking and reporting the progress of field activities are described below.

5.4.1 Daily Activities Report

To provide timely oversight of on-site contractors, complete and submit Daily Activities Reports (DARs) as described below.

5.4.1.1 Description

The DAR documents the activities and progress for each day's field work. Complete this report on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring that involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors. The DAR form can be found on the TtNUS intranet site.

5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the DAR to the FOL for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DARs are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the PM.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

In addition to those described herein, other summary reports may also be contractually required.

All TtNUS field forms can be found on the company's intranet site at http://intranet.ttnus.com under Field Log Sheets.

6.0 LISTING OF FIELD FORMS ON THE TtNUS INTRANET SITE

- Boring Log
- Container Sample and Inspection Sheet
- Daily Activities Checklist
- Daily Activities Record
- Equipment Calibration Log
- Field Task Modification Request
- Field Analytical Log sheet - Geochemical Parameters
- Groundwater Level Measurement Sheet
- Groundwater Sample Log Sheet
- Hydraulic Conductivity Test Data Sheet
- Low Flow Purge Data Sheet
- Bedrock Monitoring Well Construction (Stick Up)
- Bedrock Monitoring Well Construction Flush Mount
- Bedrock Monitoring Well Construction Open Hole
- Confining Layer Monitoring Well Construction
- Monitoring Well Development Record

- Monitoring Well Materials Certificate of Conformance
- Overburden Monitoring Well Construction Flush Mount
- Overburden Monitoring Well Construction Stick Up
- Packer Test Report Form
- Pumping Test Data Sheet
- QA Sample Log Sheet
- Soil/Sediment Sample Log Sheet
- Surface Water Sample Log Sheet
- Test Pit Log
- Field Project Pre-Mobilization Checklist

ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY

START TIME: ____________________ DATE: ____________________

SITE LEADER: ________________________________
PERSONNEL:

TtNUS	DRILLER	SITE VISITORS
____________	____________	____________
____________	____________	____________
____________	____________	____________

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well ____ resumes. Rig geologist was ______________. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well ______.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _______.
4. Well ______ drilled. Rig geologist was ___________________. See Geologist's Notebook, No. 2, page ____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _________.
8. Test pit _______ dug with cuttings placed in dump truck. Rig geologist was _______________. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit ___ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

____

Field Operations Leader

ATTACHMENT B
SAMPLE LABEL

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** **Site:** **Location:**	
Sample No:		**Matrix:**
Date:	**Time:**	**Preserve:**
Analysis:		
Sampled by:		**Laboratory:**

ATTACHMENT C
CHAIN-OF-CUSTODY RECORD FORM

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 3413 | PAGE ____ OF ______

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER		CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED
TYPE OF ANALYSIS

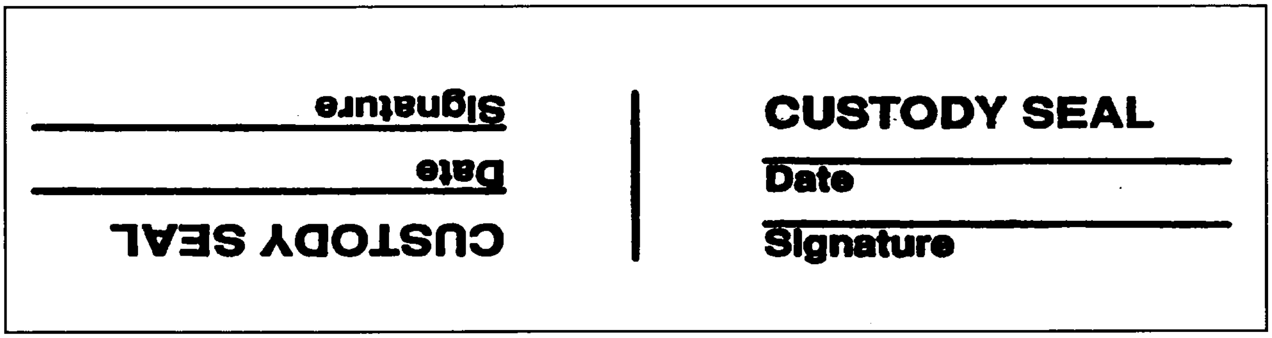
DATE YEAR ____	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS									COMMENTS

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME
COMMENTS					

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

ATTACHMENT D
CHAIN-OF-CUSTODY SEAL



TETRA TECH	STANDARD OPERATING PROCEDURES	Number SA-7.1	Page 1 of 16
		Effective Date 01/2012	Revision 7
		Applicability Tetra Tech, Inc.	
		Prepared Earth Sciences Department	
Subject DECONTAMINATION OF FIELD EQUIPMENT		Approved J. Zimmerly	

TABLE OF CONTENTS

1.0 PURPOSE

Decontamination is the process of removing and/or neutralizing site contaminants that have contacted and/or accumulated on equipment. The purpose of this Standard Operating Procedure (SOP) is to protect site personnel, the general public, and the environment while preserving or maintaining sample integrity. It is further intended through this procedure to describe the steps necessary for proper decontamination of drilling equipment, earth-moving equipment , chemical sampling equipment and field operation and analytical equipment.

2.0 SCOPE AND APPLICABILITY

This procedure applies to all equipment used to provide access to/acquire environmental samples that may have become contaminated through direct contact with contaminated media including air, water, and soil. This equipment includes drilling and heavy equipment and chemical sampling and field analytical equipment. Where technologically and economically feasible, single-use sealed disposable equipment will be employed to minimize the potential for cross-contamination. This SOP also provides general reference information on the control of contaminated materials.

Decontamination methods and equipment requirements may differ from one project to another. General equipment items are specified in Section 6.0, but project-specific equipment must be obtained to address the project-specific decontamination procedures presented in Section 7.0 and applicable subsections.

3.0 GLOSSARY

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

Decontamination Solution - A solution selected/identified in the Health and Safety Plan or Project-Specific Quality Assurance Plan. The solution is selected and employed as directed by the project chemist/health and safety professional.

Deionized Water (DI) - Tap water that has been treated by passing through a standard deionizing resin column. This water may also pass through additional filtering media to attain various levels of analyte-free status. The DI water should meet College of American Pathologists (CAP) and National Committee for Clinical Laboratory Standards (NCCLS) specifications for reagent-grade Type I water.

Potable Water - Tap water from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Pressure Washing - Process employing a high-pressure pump and nozzle configuration to create a high-pressure spray of potable water. High-pressure spray is employed to remove solids from equipment.

Solvent – A liquid in which solid chemicals or other liquids are dissolved. The solvent of choice is pesticide-grade isopropanol. Use of other solvents (methanol, acetone, or hexane) may be required for particular projects or for a particular purpose (e.g., removal of concentrated waste) and must be justified in the project planning documents. For example, it may be necessary to use hexane when analyzing for trace levels of pesticides, PCBs, or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on PVC equipment or well construction materials.

Steam Pressure Washing - A cleaning method employing a high-pressure spray of heated potable water to remove various organic/inorganic chemicals from equipment.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Decontamination Personnel - Individuals assigned the task of decontamination. It is the responsibility of these individuals to understand the use and application of the decontamination process and solutions as well as the monitoring of that process to ensure that it is working properly. This is accomplished through visual evaluation, monitoring instrument scanning of decontaminated items, and/or through the collection of rinsate blanks to verify contaminant removal.

Field Operations Leader (FOL) - Responsible for the implementation of project-specific planning documents. This includes on-site verification that all field activities are performed in compliance with approved SOPs or as otherwise dictated by the approved project plan(s). The FOL is also responsible for the completion and accuracy of all field documentation.

Site Safety Officer (SSO) - Exercises shared responsibility with the FOL concerning decontamination effectiveness. All equipment arriving on site (as part of the equipment inspection), leaving the site, and moving between locations is required to go through a decontamination evaluation. This is accomplished through visual examination and/or instrument screening to determine the effectiveness of the decontamination process. Improper or incomplete decontamination is sufficient to restrict equipment from entering the site, exiting the site, or moving to a new location on the site until the objectives are successfully completed.

General personnel qualifications for decontamination activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate decontamination procedures.

5.0 HEALTH AND SAFETY

In addition to the health and safety issues and reminders specified in subsections of this SOP, the following considerations and requirements must be observed as SOPs for field equipment decontamination activities:

- If any solvents or hazardous chemicals (e.g., isopropyl alcohol) are to be used in equipment decontamination activities, the FOL must first obtain the manufacturer's/supplier's Material Safety Data Sheet (MSDS) and assure that it is reviewed by all users (prior to its use), added to the site Hazardous Chemical Inventory, and maintained on site as part of the project Hazard Communication Program.
- Review and observe specific health and safety requirements (e.g., personal protective equipment [PPE]) specified in the project-specific health and safety plan for this activity.

6.0 EQUIPMENT LIST

- Wood for decontamination pad construction, when applicable (see Section 7.1).

- Tools for constructing decontamination pad frame, when applicable (see Section 7.1).
- Visqueen sheeting or comparable material to cover decontamination pad frame, when applicable (see Section 7.1).
- Wash/drying racks for auger flights and drill/drive rods, when applicable (see Section 7.2).
- PPE as specified in the project health and safety plan.
- Soap and water for washing and rinsing.
- Deionized water for final rinsing.
- Solvents (e.g., pesticide-grade isopropanol) for rinsing (see applicable portions of Section 7.2).
- Tubs, buckets, etc. for containerizing rinse water (see applicable portions of Section 7.2).
- Sample bottles for collecting rinsate blanks (see Section 7.2).
- Calibrated photoionization detector (PID) or flame ionization detector (FID) to monitor decontaminated equipment for organic vapors generated through the existence of residual contamination or the presence of decontamination solvent remaining after the piece was rinsed.
- Aluminum foil or clear clean plastic bag for covering cleaned equipment (see applicable portions of Section 7.2).
- Paper towels or cloths for wiping.
- Brushes, scrapers, or other hand tools useful for removing solid materials from equipment.
- Clear plastic wrap for covering or wrapping large decontaminated equipment items (see Section 7.2.2).
- Drum-moving equipment for moving filled waste drums (optional) (see Section 7.3).
- Drum labels for waste drums (see Attachment A).

7.0 PROCEDURES

The process of decontamination is accomplished through the removal of contaminants, neutralization of contaminants, or isolation of contaminants. To accomplish this activity, preparation is required including site preparation, equipment selection, and evaluation of the decontamination requirements and processes. Site contaminant types, concentrations, and media types are primary drivers in the selection of the types of decontamination and where it will be conducted. For purposes of this SOP, discussion is limited to decontamination procedures for general environmental investigations.

Decontamination processes will be performed at the location(s) specified in project-specific planning documents. Typical decontamination locations include the following:

- Temporary decontamination pads/facilities
- Sample locations
- Centralized decontamination pad/facilities

- Combination of some or all of the above

The following discussion includes general considerations for the decontamination process. Specific construction and implementation procedures will be as specified in the project-specific planning documents and/or may be as dictated by site-specific conditions as long as the intent of the requirements in the planning documents is met. This intent is to contain any residual fluids and solids generated through the decontamination process.

7.1 Decontamination Pad Design/Construction Considerations

7.1.1 Temporary Decontamination Pads

Temporary decontamination pads may be constructed at satellite locations within the site area in support of temporary work areas. These structures are generally constructed to support the decontamination of heavy equipment such as drill rigs and earth-moving equipment but can be employed for smaller articles.

The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Therefore, construction of these pads should take into account the following considerations:

- Site location – The decontamination site selected should be far enough from the work site to maximize decontamination effectiveness while minimizing travel distance. The location of the decontamination site shall be selected to provide, in the judgment of the FOL or FOL designee, compliance with as many of the following characteristics as practicable:

  - Well removed from pedestrian/vehicle thoroughfares.
  - Avoidance of areas where control/custody cannot be maintained.
  - Avoidance of areas where potential releases of contaminated media or decontamination fluids may be compounded through access to storm water transport systems, streams, or other potentially sensitive areas.
  - Avoidance of potentially contaminated areas.
  - Avoidance of areas too close to the ongoing operation, where cross-contamination may occur.

  The selected decontamination site should include the following, where possible:

  - Areas where potable water and electricity are provided.

Safety Reminder

When utilizing electrical power sources, either hard-wired or portable-generated sources, ensure that:

- All power is routed through a Ground Fault Circuit Interrupter (GFCI).

- All power cords are in good condition (no physical damage), rated for the intended energy load, and designated for outdoor use.

In situations where accomplishing these elements is not possible, it will be necessary to implement a site electrical grounding program.

Areas where support activities such as removing decontamination waters soil and sediment are possible without entering an active exclusion zone.

- Areas that offer sufficient size to carry out the specific decontamination sequence.

- Decontamination pad (decon pad) – The decon pad shall be constructed to meet the following characteristics:

  - Size – The size of the pad should be sufficient to accept the equipment to be decontaminated as well as permitting free movement around the equipment by the personnel conducting the decontamination. The size should permit these movements utilizing pressure/steam washer wands and hoses and minimizing splash due to work in close quarters.

  - Slope – An adequate slope will be constructed to permit the collection of water and potentially contaminated soil within a trough or sump constructed at one end. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. Because the pad will be sloped, place a light coating of sand over the plastic to minimize potential slips and falls. See the text about liners below.

  - Sidewalls – The sidewalls shall be at least 6 inches in height (or as high as possible if 6 inches is not achievable) to provide adequate containment for wash waters and soil. If splash represents a potential problem, splash guards should be constructed to control overspray. Sidewalls may be constructed of wood, inflatables, sand bags, etc. to permit containment. Splash guards are typically wood frames with Visqueen covering to control overspray.

  - Liner – Depending on the types of equipment and decontamination method to be used, the liner should be of sufficient thickness to provide a puncture-resistant barrier between the decontamination operation and the unprotected environment. Care should be taken to examine the surface area prior to placing the liner to remove sharp articles (sticks, stones, debris) that could puncture the liner. Liners are intended to form an impermeable barrier. The thickness may vary from a minimum recommended thickness of 10 mil to 30 mil. The desired thickness may be achieved through layering materials of lighter construction. It should be noted that various materials (rubber, polyethylene sheeting) become slippery when wet. To minimize this potential hazard associated with a sloped liner, a light coating of sand shall be applied to provide traction as necessary.

  - Wash/drying racks – Auger flights, drill/drive rods, and similar equipment require racks positioned off of the ground to permit these articles to be washed, drained, and dried while secured from falling during this process.

For decontamination of direct-push technology (DPT) equipment, the pad may be as simple as a mortar tub containing buckets of soapy water for washing and an empty bucket to capture rinse waters. Decontamination may be conducted at the rear of the rig to permit rapid tool exchange.

- Maintenance – Maintain the decontamination area by:

  - Periodically clearing the work area of standing water, soil, and debris, and coiling hoses to aid in eliminating slip, trip, and fall hazards. In addition, these articles will reduce potential backsplash and cross-contamination.

- Regularly changing the decontamination fluids to ensure proper cleaning and prevent cross-contamination.

- PPE – Periodically evaluate the condition of, and maintain the decontamination equipment, including regular cleaning of face shields and safety glasses. This is critical to ensuring the safety of decontamination personnel and the integrity of the decontamination process, and it will ensure that equipment is functioning properly.

7.1.2 Decontamination Activities at Drill Rigs/DPT Units

During subsurface sampling activities including drilling and DPT activities, decontamination of drive rods, Macro Core Samplers, split spoons, etc. is typically conducted at an area adjacent to the operation. Decontamination is generally accomplished using a soap/water wash and rinse utilizing buckets and brushes. This area requires sufficient preparation to accomplish the decontamination objectives.

Buckets shall be placed within mortar tubs or similar secondary containment tubs to prevent splash and spills from reaching unprotected environmental media. Drying racks shall be employed as directed for temporary pads to permit parts to dry and be evaluated prior to use/reuse. Methodology regarding this activity is provided in Section 7.2.

7.1.3 Decontamination Activities at Remote Sample Locations

When sampling at remote locations, sampling equipment such as trowels and pumps/tubing should be evacuated of potentially contaminated media to the extent possible. This equipment should be wrapped in plastic for transport to the temporary/centralized decontamination location for final cleaning and disposition. Flushing and cleaning of single-use equipment such as disposable trowels, tubing, and surgeon's gloves may allow disposal of this equipment after visible soil and water remnants have been removed.

7.2 Equipment Decontamination Procedures

The following represents procedures to be employed for the decontamination of equipment that may have contacted and/or accumulated contamination through site investigation activities.

7.2.1 Monitoring Well Sampling Equipment

7.2.1.1 Groundwater sampling equipment – This includes pumps inserted into monitoring wells such as bladder pumps, Whale pumps, and Redi-Flo pumps and reusable bailers, etc.

1. Evacuate to the extent possible, any purge water within the pump/bailer.
2. Scrub using soap and water and/or steam clean the outside of the pump/bailer and, if applicable, the pump tubing.
3. Insert the pump and tubing/bailer into a clean container of soapy water. Pump/run a sufficient amount of soapy water through the pump/bailer to flush out any residual well water. After the pump is flushed, circulate soapy water through the pump to ensure that the internal components are thoroughly flushed.
4. Remove the pump and tubing/bailer from the container
5. Rinse external pump components using tap water.

6. Insert the pump and tubing/bailer into a clean container of tap water. Pump/run a sufficient amount of tap water through the pump/bailer to evacuate all of the soapy water (until clear).

> ***CAUTION***
> Do not rinse PE, PVC, and associated tubing with solvents – Use the procedures defined in the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 7 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

7. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment to be cleaned with pesticide-grade isopropanol.
8. Pass deionized water through the hose to flush out the tap water and solvent residue as applicable.
9. Drain residual deionized water to the extent possible.
10. Allow components of the equipment to air dry.
11. For bladder pumps, disassemble the pump and wash the internal components with soap and water, then rinse with tap water, isopropanol, and deionized water and allow to dry. After the parts are dry, conduct a visual inspection and a monitoring instrument scan to ensure that potential contaminants and all decontamination solvent have been removed. Collect a rinsate blank in accordance with the project-specific planning documents to ensure that the decontamination process is functioning as intended. The typical frequency of collection for rinsate blanks is 1 per 20 field samples. In addition, wipe samples or field tests such as UV light may be used.
12. Wrap pump/bailer in aluminum foil or a clear clean plastic bag for storage.

> ***SAFETY REMINDER***
> Remember when handling powered equipment to disconnect the power source and render the equipment to a zero energy state (both potential and kinetic) before opening valves, disconnecting lines, etc.

7.2.1.2 Electronic Water Level Indicators/Sounders/Tapes

During water level measurements, rinsing the extracted tape and probe with deionized water and wiping the surface of the extracted tape between locations is acceptable. However, periodic full decontamination should be conducted as follows:

1. Wash with soap and water
2. Rinse with tap water
3. Rinse with deionized water

> ***NOTE***
> In situations where oil, grease, free product, other hard to remove materials are encountered, probes and exposed tapes should be washed in hot soapy water. If probes or tapes cannot be satisfactorily decontaminated (they are still stained, discolored, etc.), they should be removed from service.

7.2.1.3 Miscellaneous Equipment

Miscellaneous equipment including analytical equipment (water quality testing equipment) shall be cleaned per manufacturers' instructions. This generally includes wiping the sensor housing and rinsing with tap and deionized water.

Coolers/shipping containers employed to ship samples are received from the laboratory in a variety of conditions including marginal to extremely poor. Coolers shall be evaluated prior to use for the following:

- Structural integrity – Coolers missing handles or having breaks in the outer housing should be removed and not used. Notify the laboratory that the risk of shipping samples in the cooler(s) provided is too great and request a replacement unit.
- Cleanliness – As per protocol, only volatile organic samples are accompanied by a trip blank. If a cooler's cleanliness is in question (visibly dirty/stained) or if there are noticeable odors, the cooler should be decontaminated prior to use as follows:

  1. Wash with soap and water
  2. Rinse with tap water
  3. Dry

If these measures fail to clean the cooler to an acceptable level, remove the unit from use as a shipping container and ask the cooler provider (e.g., the analytical laboratory) to provide a replacement unit.

7.2.2 Downhole Drilling Equipment

This includes any portion of the drill rig that is over the borehole, including auger flights, drill stems, rods, and associated tooling that would extend over the borehole. The following procedure is to be employed prior to initiating the drilling/sampling activity, then between locations:

CAUTION

Exercise care when using scrapers to remove soil and debris from downhole drilling equipment. Inadvertent slips of scrapers have resulted in cuts, scrapes, and injured knuckles, so use scrapers carefully when removing soil from these items.

1. Remove loose soil using shovels, scrapers, etc.

2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment being decontaminated.

CAUTION

In Step 3, do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

3. Rinse the equipment with tap water, where applicable (steam cleaning and pressure washing incorporate rinsing as part of the process).

4. If the equipment has directly or indirectly contacted contaminated sample media and is known or suspected of being contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse equipment with pesticide-grade isopropanol

5. To the extent possible, allow components to air dry.

6. If the decontaminated equipment is to be used immediately after decontamination, screen it with a calibrated photoionization detector (PID)/flame ionization detector (FID) to ensure that all contaminants and possible decontamination solvents (if they were used) have been adequately removed.

7. Wrap or cover equipment in clear plastic until it is time to be used.

SAFETY REMINDER

Even when equipment is disconnected from power sources, dangers such as the following may persist:

Falls - An auger flight standing on its end may fall and injure someone. Secure all loose articles to prevent heavy articles from falling onto people or equipment.

Burns - Steam cleaner water is heated to more than 212 °F and exhibits thermal energy that can cause burns. Prevent contact of skin with hot water or surfaces.

High water pressure - Pressure washer discharge can have 2,000 to 4,000 psi of water pressure. Water under this amount of pressure can rupture skin and other human tissues. Water at 4,000 psi exiting a 0° tip can be dangerous because of its relatively high cutting power. The exit velocity and cutting power of the water are reduced when exiting a 40° fan tip, but damage to soft tissues is still possible.

In general, follow the rules below to avoid injury, equipment damage, or incomplete decontamination:

1. Read the operating manual and follow the manufacturers' recommended safety practices before operating pressure washers and steam cleaners.

2. Never point the pressure washer or steam cleaner at another person or use to clean your boots or other parts of your body. Water lacerations and burns may appear to be minor at first but can be life threatening. Do not attempt to hold small parts in your hand while washing them with high-temperature or high-pressure water.

3. Always wear PPE as specified in the HASP such as:

   - Hard hat, safety glasses, splash shield, impermeable apron or splash suit, and hearing protection. Remember that excessive noise is a hazard when operating gas-powered engines and electrically driven pressure washers. PPE will be identified in your project specific planning documents.

4. Inspect each device before use. An inspection checklist will be provided in the project-specific planning documents. If it is a rented device, safety measures are typically provided by the vendor. In all cases, if you are not familiar with the operation of a pressure washer/steam cleaner, do not operate it until you obtain and thoroughly review operating instructions and recommended safety practices.

5. Do not modify equipment unless the manufacturer has approved the modifications.

7.2.3 Soil/Sediment Sampling Equipment

This section applies to soil sampling equipment including but not limited to hand augers, stainless steel trowels/spoons, bowls, dredges, scoops, split spoons, Macro Core samplers, etc.

1. Remove all loose soil from the equipment through manual means.

2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment.

3. Rinse the equipment with tap water.

> ***CAUTION***
>
> Do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

4. If the equipment is contaminated or suspected to be contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment with pesticide-grade isopropanol.

5. Rinse the equipment with deionized water.

6. To the extent possible, allow components to air dry.

7. If the equipment is to be used immediately after decontamination, screen it with a calibrated PID/FID to ensure that all solvents (if they were used) and trace contaminants have been adequately removed.

8. After the equipment has dried, wrap it in aluminum foil for storage until use.

Dredges employed in sediment sampling are typically decontaminated as follows:

- Remove the sediment sample from the sampling device

- If sufficient associated surface water is available at the sampling site, place the dredge in the water and flush to remove visible sediment.

- Extract the dredge and wash it in soap and water per the project-specific planning documents.

> ***CAUTION***
>
> When handling dredges, the primary safety concern is trapping fingers or extremities in the larger dredge samplers within the jaws or pinch points of the mechanical jaws. Keep hands, fingers, and extremities away from these pinch and compression points. Either handle the device by the rope or preferably lock the jaws in place to control the potential for closing during maintenance and/or cleaning.

7.3 Contact Waste/Materials

During the course of field investigations, disposable/single-use equipment becomes contaminated. These items include tubing, trowels, PPE (gloves, overboots, splash suits, etc.), and broken sample containers.

With the exception of the broken glass, single-use articles should be cleaned (washed and rinsed) of visible materials and disposed as normal refuse. The exception to this rule is that extremely soiled materials that cannot be cleaned shall be containerized for disposal in accordance with applicable federal, state, and local regulations.

7.3.1 Investigation-Derived Wastes - Decontamination Wash Waters and Sediments

> ***NOTE***
> Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage areas will be provided in project-specific documents, or separate direction will be provided by the Project Manager.

1. Assume that all investigation-derived waste (IDW) generated from decontamination activities contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

2. Where possible, use filtering systems to extend the use of water within a closed system wash unit to recycle water and to reduce possible waste amounts.

> ***NOTE***
> Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.

3. Label waste storage containers appropriately labeled (see Attachment A).

4. Ensure that the IDW storage area is configured to meet the following specifications to permit access to the containers and to conduct spill/leak monitoring, sampling, and extraction when the disposal route is determined:

   - Enclose areas accessible by the general public using construction fencing and signs.
   - Stored materials in 55-gallon drums on pallets with four (or fewer) drums per pallet.
   - Maintain the retaining bolt and label on the outside of storage containers where readily visible.
   - Provide at least 4 feet of room between each row of pallets to allow access to containers for sampling, drum removal, and spill response.
   - As directed in project-specific planning documents, maintain an IDW Inventory List and provide the list to the site Point of Contact at the termination of each shift.
   - Maintain spill response equipment at the IDW storage area in case it is required for immediate access.

- Where possible, use equipment for moving containers. Where not possible, obtain help to manipulate containers.

CAUTION

Each container of water can weigh up to 490 pounds. Each 55-gallon drum of wet soil can weigh more than 750 pounds. Fill drums and temporary containers to 80 percent capacity to minimize spill and handling difficulties. Use drum carts to move filled drums.

See safe lifting techniques provided in Section 4.4 of the Tetra Tech NUS, Inc. Health and Safety Guidance Manual.

When placing drums, keep your fingers out of pinch and smash points such as between the drums. In some cases such as well development and/or purge water, you can place the drums to be filled on the pallet and transport materials in smaller easier to handle containers.

7.4 Decontamination Evaluation

Upon decontamination of equipment, determine the effectiveness of the decontamination process in the following manner:

- Visual evaluation – A visual evaluation will be conducted to ensure the removal of particulate matter. This shall be done to ensure that the washing/rinsing process is working as intended.

- ~~Instrument Screening – A properly calibrated PID/FID should be used to evaluate the presence of site contaminants and solvents used in the cleaning process. The air intake of the instrument shall be passed over the article to be evaluated. Avoid placing the instrument probe into residual waters. A PID/FID reading greater than the daily established background level requires a repeat of the decontamination process, followed by rescreening with the PID/FID. This sequence must be repeated until no instrument readings greater than the daily established background level are observed. It should be noted that the instrument scan is only viable if the contaminants are detectable within the instrument's capabilities.~~

NOTE

When required by project-specific planning documents, collection of rinsate blanks (see next step) shall be completed without exception unless approval to not collect these samples is obtained from the Project Manager.

- Collection of Rinsate Blanks – It is recommended that rinsate samples be collected to:

  - Evaluate the decontamination procedure representing different equipment applications (pumps versus drilling equipment) and different decontamination applications.

  - Single-use disposable equipment – The number of samples should represent different types of equipment as well as different lot numbers of single-use articles.

  - The collection and the frequency of collection of rinsate samples are as follows unless specified differently in the project-specific planning documents:

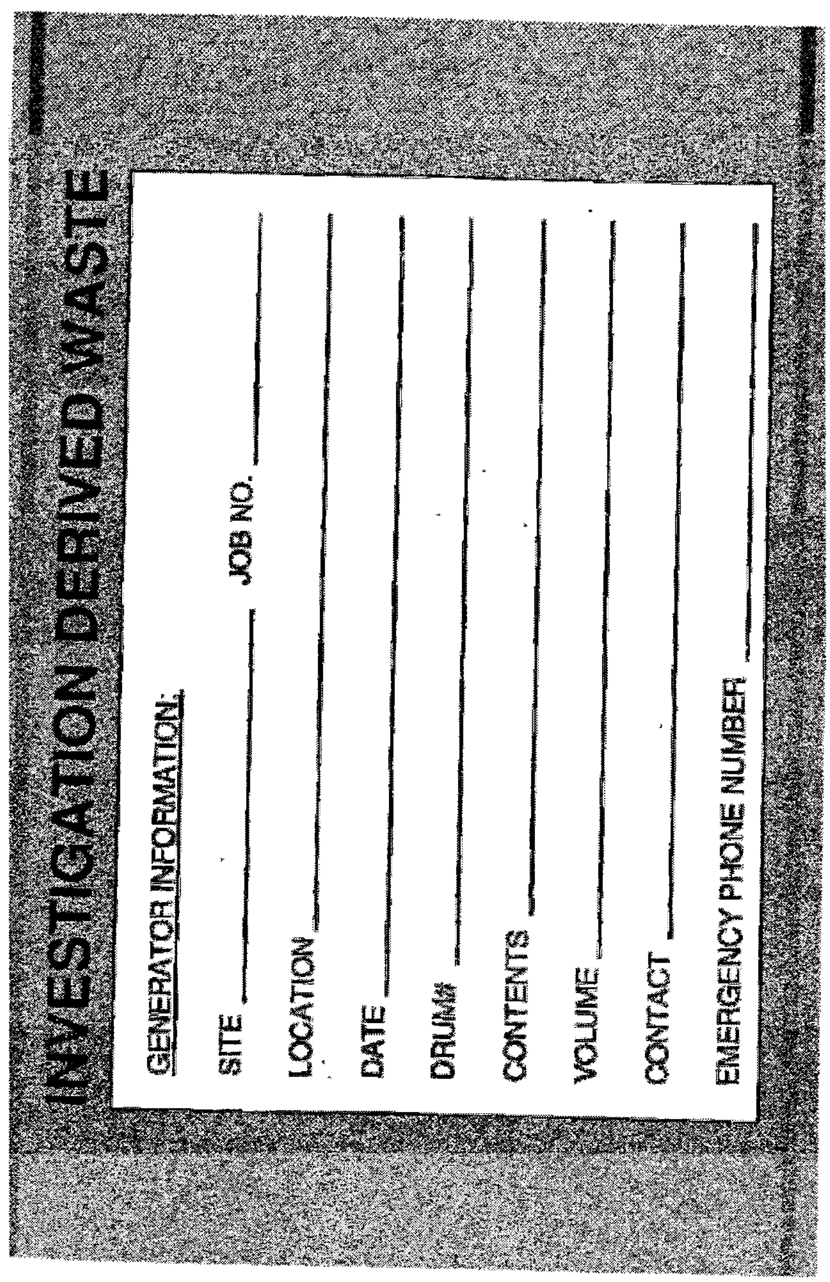
    - Per decontamination method
    - Per disposable article/batch number of disposable articles

NOTE

It is recommended that an initial rinsate sample be collected early in the project to ensure that the decontamination process is functioning properly and to avoid using a contaminated batch of single-use articles. It is recommended that a follow-up sample be collected later during the execution of the project to ensure that those conditions do not change.

Rinsate samples collection may be driven by types of and/or levels of contaminant. Difficult to remove contaminants, oils/greases, some PAHs/PCBs, etc. may also support the collection of additional rinsates due to the obvious challenges to the decontamination process. This is a field consideration to be determined by the FOL.

Attachment A
iDW Label



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SECTION **PAGE**

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to specify a consistent sample nomenclature system that will facilitate subsequent data management in a cost-effective manner. The sample nomenclature system has been devised such that the following objectives can be attained:

- Sorting of data by matrix
- Sorting of data by depth
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints (maximum of 20 characters)

2.0 SCOPE

The methods described in this SOP shall be used consistently for all projects requiring electronic data. Other contract- or project-specific sample nomenclature requirements may also be applicable.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Program Manager - It shall be the responsibility of the Project Manager (or designee) to inform contract-specific Project Managers (PMs) of the existence and requirements of this SOP.

Project Manager - It shall be the responsibility of the PM to determine the applicability of this SOP based on: (1) program-specific requirements and (2) project size and objectives. It shall be the responsibility of the PM (or designee) to ensure that sample nomenclature requirements are thoroughly specified in the relevant project planning document (e.g., sampling and analysis plan) and are consistent with this SOP if relevant. It shall be the responsibility of the PM to ensure that the FOL is familiar with the sample nomenclature system.

Field Operations Leader (FOL) - It shall be the responsibility of the FOL to ensure that all field technicians or sampling personnel are thoroughly familiar with this SOP and the project-specific sample nomenclature system. It shall be the responsibility of the FOL to ensure that the sample nomenclature system is used during all project-specific sampling efforts.

General personnel qualifications for sample nomenclature activities in the field include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.

- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.

- Familiarity with appropriate procedures for field documentation, handling, packaging, and shipping.

5.0 PROCEDURES

5.1 INTRODUCTION

The sample identification (ID) system can consist of as few as eight but not more than 20 distinct alpha-numeric characters. The sample ID will be provided to the laboratory on the sample labels and chain-of-custody forms. The basic sample ID provided to the laboratory has three segments and shall be as follows, where "A" indicates "alpha," and "N" indicates "numeric":

A or N 3 or 4 Characters	AAA 2 or 3 Characters	A or N 3 to 6 Characters
Site Identifier	Sample Type	Sample Location

Additional segments may be added as needed. For example:

(1) Soil and sediment sample ID

A or N 3 or 4 Characters	AAA 2 or 3 Characters	A or N 3 to 6 Characters	NNNN 4 Characters
Site identifier	Sample type	Sample location	Sample depth

(2) Aqueous (groundwater or surface water) sample ID

A or N 3 or 4 Characters	AAA 2 or 3 Characters	A or N 3 to 6 Characters	NN 2 Characters	-A 1 Character
Site identifier	Sample type	Sample location	Round number	Filtered sample only

(3) Biota sample ID

A or N 3 or 4 Characters	AAA 2 or 3 Characters	A or N 3 to 6 Characters	AA 2 Characters	NNN 3 Characters
Site identifier	Sample type	Sample location	Species identifier	Sample group number

5.2 SAMPLE IDENTIFICATION FIELD REQUIREMENTS

The various fields in the sample ID include but are not limited to the following:

- Site identifier
- Sample type
- Sample location
- Sample depth
- Sampling round number
- Filtered
- Species identifier
- Sample group number

The site identifier must be a three- or four-character field (numeric characters, alpha characters, or a mixture of alpha and numeric characters may be used). A site number is necessary because many facilities/sites have multiple individual sites, Solid Waste Management Units (SWMUs), Operable Units (OUs), etc. Several examples are presented in Section 5.3 of this SOP.

The sample type must be a two- or three-character alpha field. Suggested codes are provided in Section 5.3 of this SOP.

The sample location must be at least a three-character field but may have up to six characters (alpha, numeric, or a mixture). The six characters may be useful in identifying a monitoring well to be sampled or describing a grid location.

The sample depth field is used to note the depth below ground surface (bgs) at which a soil or sediment sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom interval in feet bgs of the sample. If the sample depth is equal to or greater than 100, then only the top interval would be represented and the sampling depth would be truncated to three characters. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet or boring log, in the logbook, etc.

A two-digit round number will be used to track the number of aqueous samples collected from a particular aqueous sample location. The first sample collected from a location will be assigned the round identifier 01, the second 02, etc. This applies to both existing and proposed monitoring wells and surface water locations.

Aqueous samples that are field filtered (dissolved analysis) will be identified with an "-F" in the last field segment. No entry in this segment signifies an unfiltered (total) sample.

The species identifier must be a two-character alpha field. Several suggested codes are provided in Section 5.3 of this SOP.

The three-digit sample group number will be used to track the number of biota sample groups (a particular group size may be determined by sample technique, media type, the number of individual caught, weight issues, time, etc.) by species and location. The first sample group of a particular species collected from a given location will be assigned the sample group number 001, and the second sample group of the same species collected from the same location will be assigned the sample group number 002.

5.3 EXAMPLE SAMPLE FIELD DESIGNATIONS

Examples of each of the fields are as follows:

Site identifier - Examples of site numbers/designations are as follows:

A01 - Area of Concern (AOC) 1
125 - SWMU 125
000 - Base- or facility-wide sample (e.g., upgradient well)
BBG - Base background

The examples cited are only suggestions. Each PM (or designee) must designate appropriate (and consistent) site designations for their individual project.

Sample type - Examples of sample types are as follows:

AH - Ash Sample
AS - Air Sample
BM - Building Material Sample

BSB - Biota Sample Full Body
BSF - Biota Sample Fillet
CP - Composite Sample
CS - Chip Sample
DS - Drum Sample
DU - Dust Sample
FP - Free Product
IDW - Investigation-Derived Waste Sample
LT - Leachate Sample
MW - Monitoring Well Groundwater Sample
OF - Outfall Sample
RW - Residential Well Sample
SB - Soil Boring Sample
SD - Sediment Sample
SC - Scrape Sample
SG - Soil Gas Sample
SL - Sludge Sample
SP - Seep Sample
SS - Surface Soil Sample
ST - Storm Sewer Water Sample
SW - Surface Water Sample
TP - Test Pit Sample
TW - Temporary Well Sample
WC - Well Construction Material Sample
WP - Wipe Sample
WS - Waste/Solid Sample
WW - Wastewater Sample

Sample location - Examples of the location field are as follows:

001 - Monitoring well 1
N32E92 - Grid location 32 North and 92 East
D096 - Investigation-derived waste drum number 96

Species identifier - Examples of species identifier are as follows:

BC - Blue Crab
GB - Blue Gill
CO - Corn
SB - Soybean

5.4 EXAMPLES OF SAMPLE NOMENCLATURE

The first round monitoring well groundwater sample collected from existing monitoring well 001 at SWMU 16 for a filtered sample would be designated as 016MW00101-F.

The second round monitoring well groundwater sample collected from existing monitoring well C20P2 at Site 23 for an unfiltered sample would be designated as 023MWC20P202.

The second surface water sample collected from point 01 at SWMU 130 for an unfiltered sample would be designated as 130SW00102.

A surface soil sample collected from grid location 32 North and 92 East at Site 32 at the 0- to 2-foot interval would be designated as 032SSN32E920002.

A subsurface soil sample from soil boring 03 at SWMU 32 at an interval of 4 to 5 feet bgs would be designated as 032SB0030405.

A sediment sample collected at SWMU 19 from 0 to 6 inches at location 14 would be designated as 019SD0140001. The sample data sheet would reflect the precise depth at which this sample was collected.

During biota sampling for full-body analysis, the first time a minnow trap was checked at grid location A25 of SWMU 1415, three small blue gills were captured, collected, and designated with the sample ID of 1415BSBA25BG001. The second time blue gill were collected at the same location (grid location A25 at SWMU 1415), the sample ID would be 1415BSBA25BG002.

Note: No dash (-) or spacing is used between the segments with the exception of the filtered segment. The "F" used for a filtered aqueous sample is preceded by a dash (-F).

5.5 FIELD QA/QC SAMPLE NOMENCLATURE

Field Quality Assurance (QA)/Quality Control (QC) samples are designated using a different coding system. The QC code will consist of a three- to four-segment alpha-numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN	-F
QC type	Date	Sequence number (per day)	Filtered (aqueous only, if needed)

The QC types are identified as:

TB = Trip Blank
RB = Rinsate Blank (Equipment Blank)
FD = Field Duplicate
AB = Ambient Conditions Blank
WB = Source Water Blank

The sampling time recorded on the chain-of-custody form, labels, and tags for duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the routine sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory). Documentation for all other QC types (TB, RB, AB, and WB) will be recorded on the QC Sample Log Sheet (see SOP SA-6.3, Field Documentation).

5.6 EXAMPLES OF FIELD QA/QC SAMPLE NOMENCLATURE

The first duplicate of the day for a filtered groundwater sample collected on June 3, 2000, would be designated as FD06030001-F.

The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2003, would be designated as FD11170303.

The first trip blank associated with samples collected on October 12, 2000, would be designated as TB10120001.

The only rinsate blank collected on November 17, 2001, would be designated as RB11170101.

6.0 DEVIATIONS

Any deviation from this SOP must be addressed in detail in the site-specific planning documents.

TG&B Vibrocoring Procedure

1.0 Safety

1.1 Before working, check all boat rigging, cables, shackles and cotter pins.

1.2 When getting to the work site, raise the 'ball-diamond-ball' shapes and announce your activity, location and duration on marine channel 13.

2.0 Getting on Station

2.1 Position the boat on the approximate core location, determine whether the wind or current is dominant (setting direction). Note that all positioning is dependant on vessel traffic and the channel orientation.

2.2 Run the boat approximately 100 feet up wind (or current) and set the bow anchor.

2.3 Back down to the core location. When on station, lower spuds. If the water depth is too deep for spudding, set 2 anchors (one off each stern quarter) out approximately 100 feet.

2.4 Insure anchor lines are tight and the boat is not drifting.

3.0 Core Preparation

3.1 Measure and log water depth with weighted tape. Refer to tide table for tide correction. Calculate MLW water depth and record it.

3.2 Cut core tube to 1.5 inches longer than core pipe and deburr ends.

3.3 Thread plunger cable through tube, attach plunger and set it 4-5 inches inside tube.

3.4 Insert retaining fingers in lower end and insert core tube in core pipe. Check bottom end for proper seating.

3.5 Mark on core pipe (or topping pipe if deeper) the measured water depth. Measure and mark on topping pipe distance to required penetration.

4.0 Coring Operation

4.1 Review responsibilities between captain and coring engineer. Put on nitrile gloves and hearing protection.

4.2 Start air compressor.

4.3 Raise the vibrator head to shoulder level and bolt in core pipe.

4.4 Insure that the plunger wire is properly fed and clear.

4.5 Lower coring assembly so that the depth mark is at the waterline.

4.6 Secure (cleat) plunger cable.

4.7 Simultaneously slack off the main winch wire and open the valve to introduce air to the vibrator.

4.8 Continue coring operation until the required penetration depth is attained or progress is stopped (refusal).

4.9 Record penetration depth.

4.10 Using the main winch wire, retrieve coring assembly. Raise it to approximately head level.

4.11 Uncleat the plunger wire.

4.12 Put a stopper line on the core pipe and unbolt the core pipe from the vibrator.
4.13 Remove the core pipe, taking the top end forward.
4.14 Carefully remove the core barrel, cap and tape both ends.
4.15 Measure recovery and log it.
4.16 Mark station number, top end, penetration and recovery data on the tube.
4.17 Stand core up vertically and secure it.

5.0 Deconn

5.1 Deconn core pipe end, plunger and fingers in preparation for next station.

APPENDIX B

FIELD FORMS

- BORING LOG
- SOIL & SEDIMENT SAMPLE LOG SHEET
- QA SAMPLE LOG SHEET
- FIELD TASK MODIFICATION REQUEST FORM
- DAILY ACTIVITIES RECORD
- DAILY ACTIVITIES CHECKLIST

Tetra Tech

BORING LOG

PROJECT NAME: ____________ BORING No.: ____________
PROJECT NUMBER: ____________ DATE: ____________
DRILLING COMPANY: ____________ GEOLOGIST: ____________
DRILLING RIG: ____________ DRILLER: ____________

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: ____________

Drilling Area Background (ppm): ____

Converted to Well: Yes ______ No ______ Well I.D. #: ____________

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: ______________________
Project No.: ______________________

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: ______________________
[] QA Sample Type: ______________________

Sample ID No.: ______________
Sample Location: ______________
Sampled By: ______________
C.O.C. No.: ______________

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech

QA SAMPLE LOG SHEET

Project Site Name: ______________ Sample ID Number: ______________
Project Number: ______________ Sampled By: ______________
Sample Location: ______________ C.O.C. Number: ______________
QA Sample Type:

[] Trip Blank [] Rinsate Blank
[] Source Water Blank [] Other Blank ______________

SAMPLING DATA:	**WATER SOURCE:**
Date: ______________ Time: ______________ Method: ______________	[] Laboratory Prepared [] Tap [] Purchased [] Fire Hydrant [] Other ______________

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):	**RINSATE INFORMATION (If Applicable):**
Product Name: ______________ Supplier: ______________ Manufacturer: ______________ Order Number: ______________ Lot Number: ______________ Expiration Date: ______________	Media Type: ______________ Equipment Used: ______________ Equipment Type: [] Dedicated [] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Volatiles	Cool 4°C & HCl		YES / NO
Semivolatiles	Cool 4°C		YES / NO
Pesticide / PCB	Cool 4°C		YES / NO
Metals	Cool 4°C & HNO_3		YES / NO
Cyanide	Cool 4°C & NaOH		YES / NO

OBSERVATIONS / NOTES:

Signature(s):

TETRA TECH
FIELD TASK MODIFICATION REQUEST FORM

Project/Installation Name	CTO & Project Number	Task Mod. Number
Modification To (e.g. Work Plan)	Site/Sample Location	Date

Activity Description: ____________________

Reason for Change: ____________________

Recommended Disposition: ____________________

Field Operations Leader (Signature) ____________________ Date ____________________

Approved Disposition:

Project/Task Order Manager (Signature) ____________________ Date ____________________

Distribution:

Program/Project File –
Project/Task Order Manager –
Field Operations Leader –

Other: ____________________

Tetra Tech

DAILY ACTIVITIES RECORD

PROJECT NAME:		**PROJECT NUMBER:**	
CLIENT:		**LOCATION:**	
DATE:		**ARRIVAL TIME:**	
Tt PERSONNEL:		**DEPARTURE TIME:**	
CONTRACTOR:		**DRILLER:**	

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS:

APPROVED BY:

TETRA TECH REPRESENTATIVE

DRILLER

DATE:

Tetra Tech

PROJECT: ______________________________ JOB #: ______________________
LOCATION: ______________________________ DATE: ______________________
PROJECT MANAGER: ______________________ FOL: ________________________

DAILY ACTIVITIES CHECKLIST

Startup Checklist

Activity	Yes	No	N/A
Pertinent site activities/information entered into site logbook			
All onsite personnel listed in logbook			
Required medical information onsite for all workers (Tetra Tech and Subcontractors)			
Required MSDS's onsite			
Proper equipment calibrations performed (list equipment)			
1 ______________________			
2 ______________________			
3 ______________________			
4 ______________________			
Calibration logs filled out			
Tailgate H&S meeting held prior to beginning field activities			
Required work permits filled out/signed			
Required utility clearances obtained			
Required PPE onsite and in use			
Information required to be posted is in place			
(OSHA poster, hospital route, key phone numbers, etc.)			

Exit Checklist

Activity	Yes	No	N/A
Logbooks completely and comprehensively filled out			
Field forms complete and accounted for/properly filed			
Samples properly packaged/shipped			
COCs faxed to appropriate in-house personnel			
All equipment accounted for, on charge if needed, and properly secured			
All personnel accounted for			
Arrangements made for upcoming work (permits, clearances, equipment, etc.)			
Site properly secured			

Note - not all items listed apply to every job, and some additional requirements may apply on a job-specific basis.

APPENDIX C

LABORATORY DOD ELAP ACCREDITATION AND STATE CERTIFICATION

LABORATORY
ACCREDITATION
BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 **Certificate Number L2247**

Spectrum Analytical, Inc.

featuring Hanibal Technology, Rhode Island Division

175 Metro Center Blvd
Warwick, RI 02886

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: April 1, 2013

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 26th of July 2010

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2247

Scope of Accreditation
For
Spectrum Analytical, Inc.
featuring Hanibal Technology, Rhode Island Division

175 Metro Center Blvd.
Warwick, RI 02886
Sharyn Lawler
401-732-3400

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Spectrum Analytical, Inc., featuring Hanibal Technology, Rhode Island Division to perform the following tests:

Accreditation granted through: **April 1, 2013**

Testing – Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloropropane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Isopropyltoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl Chloride
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Diethyl Ether
GC/MS	EPA 8260C	Diisopropyl ether
GC/MS	EPA 8260C	Ethanol
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethyl tert-butyl ether
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Hexachloroethane
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutyl alcohol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	m,p-Xylene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methyl tert-butyl ether
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	tert-Amyl Methyl ether
GC/MS	EPA 8260C	tert-Butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Tetrachloroethene
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Trichloroethene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	Xylene (Total)
GC/MS	EPA 8270D	1,1´-Biphenyl
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1-Methylnaphthalene
GC/MS	EPA 8270D	2,2´-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	3,3´-Dichlorobenzidine
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	4-Bromophenyl-phenylether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl-phenylether
GC/MS	EPA 8270D	4-Methylphenol
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzyl Alcohol
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270D	Bis(2-chloroethyl)ether
GC/MS	EPA 8270D	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270D	Butylbenzylphthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Di-n-butylphthalate
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethylphthalate
GC/MS	EPA 8270D	Dimethylphthalate
GC/MS	EPA 8270D	Di-n-octylphthalate
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	N-Nitroso-di-n-propylamine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/ECD	EPA 8081B	4,4´-DDD
GC/ECD	EPA 8081B	4,4´-DDE
GC/ECD	EPA 8081B	4,4´-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	beta-BHC
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene
GC/ECD	EPA 8081B	Chlordane (technical)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082A	2,2',4,5,5'-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,3,3’,4,4’-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,3,4,4',5-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,3’,4,4’,5’-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,3',4,4',5'-Pentachlorobiphenyl
GC/ECD	EPA 8082A	3,3',4,4',5-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,2’,3,3’,4,4’-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,4',5'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2',4,4',5,5'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,3,3′,4,4′,5-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,3,3',4,4',5'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,3',4,4',5-Pentachlorobiphenyl
GC/ECD	EPA 8082A	3,3'4,4',5,5'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,3',4,4',5-Heptachlorobiphenyl
GC/ECD	EPA 8082A	2,2',5-Trichlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,4',5,5'-Heptachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,4',5',6-Heptachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,3',5,6'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4',5,5',6-Heptachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,4',6'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl
GC/ECD	EPA 8082A	Decachlorobiphenyl
GC/ECD	EPA 8082A	2,4,4'-Trichlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,5'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,2',4,5'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,2',5,5'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,3',4,4'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	3,3',4,4'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,4’-Dichlorobiphenyl
GC/ECD	EPA 8082A	3,4,4',5-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,5'-Pentachlorobiphenyl
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
GC/MS/SIM	EPA 680Mod	Decachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Dichlorobiphenyl
GC/MS/SIM	EPA 680Mod	Heptachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Hexachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Monochlorobiphenyl
GC/MS/SIM	EPA 680Mod	Nonachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Octachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Pentachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Tetrachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Trichlorobiphenyl
GC/MS/SIM	EPA 680Mod	Total PCBs
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/FID	EPA 8015D	Diesel Range Organics
GC/FID	EPA 8015D	Gasoline Range Organics
ICP/AES	EPA 6010C	Aluminum
ICP/AES	EPA 6010C	Antimony
ICP/AES	EPA 6010C	Arsenic
ICP/AES	EPA 6010C	Barium
ICP/AES	EPA 6010C	Beryllium
ICP/AES	EPA 6010C	Boron

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP/AES	EPA 6010C	Cadmium
ICP/AES	EPA 6010C	Calcium
ICP/AES	EPA 6010C	Chromium
ICP/AES	EPA 6010C	Cobalt
ICP/AES	EPA 6010C	Copper
ICP/AES	EPA 6010C	Iron
ICP/AES	EPA 6010C	Lead
ICP/AES	EPA 6010C	Magnesium
ICP/AES	EPA 6010C	Manganese
ICP/AES	EPA 6010C	Molybdenum
ICP/AES	EPA 6010C	Nickel
ICP/AES	EPA 6010C	Potassium
ICP/AES	EPA 6010C	Selenium
ICP/AES	EPA 6010C	Silver
ICP/AES	EPA 6010C	Sodium
ICP/AES	EPA 6010C	Thallium
ICP/AES	EPA 6010C	Tin
ICP/AES	EPA 6010C	Vanadium
ICP/AES	EPA 6010C	Zinc
ICP/AES	SM 2340 B	Hardness, Ca/Mg (As CaCO3) BY CALCULATION
ICP/MS	EPA 6020A	Aluminum
ICP/MS	EPA 6020A	Antimony
ICP/MS	EPA 6020A	Arsenic
ICP/MS	EPA 6020A	Barium
ICP/MS	EPA 6020A	Beryllium
ICP/MS	EPA 6020A	Cadmium
ICP/MS	EPA 6020A	Calcium
ICP/MS	EPA 6020A	Chromium
ICP/MS	EPA 6020A	Cobalt
ICP/MS	EPA 6020A	Copper
ICP/MS	EPA 6020A	Iron
ICP/MS	EPA 6020A	Lead
ICP/MS	EPA 6020A	Magnesium
ICP/MS	EPA 6020A	Manganese
ICP/MS	EPA 6020A	Nickel

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP/MS	EPA 6020A	Potassium
ICP/MS	EPA 6020A	Selenium
ICP/MS	EPA 6020A	Silver
ICP/MS	EPA 6020A	Sodium
ICP/MS	EPA 6020A	Thallium
ICP/MS	EPA 6020A	Vanadium
ICP/MS	EPA 6020A	Zinc
CVAA	EPA 7470A	Mercury
FIA	EPA 9012B	Total Cyanide
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrogen, Nitrate (As N)
IC	EPA 9056A	Nitrogen, Nitrite (As N)
FIA	EPA 353.2	Nitrogen, Nitrate-Nitrite
IC	EPA 9056A	ortho-Phosphate (As P)
UV/VIS	SM 4500 P B(5)+E 18th ED	Total Phosphorus
IC	EPA 9056A	Sulfate
IC	EPA 300.0 mod.	Acetic Acid
IC	EPA 300.0 mod.	Butyric Acid
IC	EPA 300.0 mod.	Lactic Acid
IC	EPA 300.0 mod.	Propionic Acid
IC	EPA 300.0 mod.	Pyruvic Acid
UV/VIS	SM 4500 S2- D 20th ED	Sulfide
combustion/IR	EPA 9060A	Organic Carbon, Total
UV/VIS	SM 3500 Cr D 18th ED	Chromium, Hexavalent
Pensky-Marten	EPA 1010	Ignitability
pH meter	SM 4500 H+B 18th ED	pH
UV/VIS	SM 4500 NH3 B,C 18th ED	Ammonia-N
UV/VIS	SM 4500 N Org C 20th ED	TKN-N
Titration	SM 2320 B 20th ED	Alkalinity, Total (As CaCO3)
Gravimetric	SM 2540 C 20th ED	Total Dissolved Solids
Gravimetric	SM 2540 D 20th ED	Total Suspended Solids
Gravimetric	EPA 1664A	Oil & Grease, Total Recoverable
Conductivity Meter	EPA 120.1	Specific Conductance

Non-Potable Water		
Technology	**Method**	**Analyte**
UV/VIS	SM 5220 D 20th ED	Chemical Oxygen Demand
UV/VIS	SM 3500 Fe B 20th ED	Ferrous Iron
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Methane
Preparation	**Method**	**Type**
Organic Preparation	EPA 3510C	Separatory Funnel
Organic Preparation	EPA 3520C	Continuous Liquid Liquid
Inorganic Preparation	EPA 3005A	Hotblock
Inorganic Preparation	EPA 3010A	Hotblock
Volatile Organic Preparation	EPA 5030B	Purge and Trap

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
CVAA	EPA 7471B	Mercury
FIA	EPA 9012B	Total Cyanide
Titration	WALKLEY BLACK	Organic Carbon, Total
Combustion/IR	EPA 9060A	Organic Carbon, Total
Combustion/IR	Lloyd Kahn	Organic Carbon, Total
UV/VIS	EPA 7196A	Chromium, Hexavalent
Oven	ASTM D2216	Percent moisture
pH meter	EPA 9045C	pH
ICP/AES	EPA 6010C	Aluminum
ICP/AES	EPA 6010C	Antimony
ICP/AES	EPA 6010C	Arsenic
ICP/AES	EPA 6010C	Barium
ICP/AES	EPA 6010C	Beryllium
ICP/AES	EPA 6010C	Boron
ICP/AES	EPA 6010C	Cadmium
ICP/AES	EPA 6010C	Calcium
ICP/AES	EPA 6010C	Chromium
ICP/AES	EPA 6010C	Cobalt
ICP/AES	EPA 6010C	Copper

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
ICP/AES	EPA 6010C	Iron
ICP/AES	EPA 6010C	Lead
ICP/AES	EPA 6010C	Magnesium
ICP/AES	EPA 6010C	Manganese
ICP/AES	EPA 6010C	Molybdenum
ICP/AES	EPA 6010C	Nickel
ICP/AES	EPA 6010C	Potassium
ICP/AES	EPA 6010C	Selenium
ICP/AES	EPA 6010C	Silver
ICP/AES	EPA 6010C	Sodium
ICP/AES	EPA 6010C	Thallium
ICP/AES	EPA 6010C	Tin
ICP/AES	EPA 6010C	Vanadium
ICP/AES	EPA 6010C	Zinc
ICP/MS	EPA 6020A	Aluminum
ICP/MS	EPA 6020A	Antimony
ICP/MS	EPA 6020A	Arsenic
ICP/MS	EPA 6020A	Barium
ICP/MS	EPA 6020A	Beryllium
ICP/MS	EPA 6020A	Cadmium
ICP/MS	EPA 6020A	Calcium
ICP/MS	EPA 6020A	Chromium
ICP/MS	EPA 6020A	Cobalt
ICP/MS	EPA 6020A	Copper
ICP/MS	EPA 6020A	Iron
ICP/MS	EPA 6020A	Lead
ICP/MS	EPA 6020A	Magnesium
ICP/MS	EPA 6020A	Manganese
ICP/MS	EPA 6020A	Nickel
ICP/MS	EPA 6020A	Potassium
ICP/MS	EPA 6020A	Selenium
ICP/MS	EPA 6020A	Silver
ICP/MS	EPA 6020A	Sodium
ICP/MS	EPA 6020A	Thallium

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
ICP/MS	EPA 6020A	Vanadium
ICP/MS	EPA 6020A	Zinc
GC/FID	EPA 8015D	Diesel Range Organics
GC/FID	EPA 8015D	Gasoline Range Organics
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
GC/ECD	EPA 8082A	2,2',4,5,5'-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,3,3’,4,4’-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,3,4,4',5-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,3’,4,4’,5’-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,3',4,4',5'-Pentachlorobiphenyl
GC/ECD	EPA 8082A	3,3',4,4',5-Pentachlorobiphenyl
GC/ECD	EPA 8082A	2,2’,3,3’,4,4’-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,4',5'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2',4,4',5,5'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,3,3′,4,4′,5-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,3,3',4,4',5'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,3',4,4',5-Pentachlorobiphenyl
GC/ECD	EPA 8082A	3,3'4,4',5,5'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,3',4,4',5-Heptachlorobiphenyl
GC/ECD	EPA 8082A	2,2',5-Trichlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,4',5,5'-Heptachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,4',5',6-Heptachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,3',5,6'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4',5,5',6-Heptachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,4',6'-Hexachlorobiphenyl
GC/ECD	EPA 8082A	2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082A	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl
GC/ECD	EPA 8082A	Decachlorobiphenyl
GC/ECD	EPA 8082A	2,4,4'-Trichlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,5'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,2',4,5'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,2',5,5'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,3',4,4'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	3,3',4,4'-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,4'-Dichlorobiphenyl
GC/ECD	EPA 8082A	3,4,4',5-Tetrachlorobiphenyl
GC/ECD	EPA 8082A	2,2',3,4,5'-Pentachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Decachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Dichlorobiphenyl
GC/MS/SIM	EPA 680Mod	Heptachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Hexachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Monochlorobiphenyl
GC/MS/SIM	EPA 680Mod	Nonachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Octachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Pentachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Tetrachlorobiphenyl
GC/MS/SIM	EPA 680Mod	Trichlorobiphenyl
GC/MS/SIM	EPA 680Mod	Total PCBs
GC/ECD	EPA 8081B	4,4´-DDD
GC/ECD	EPA 8081B	4,4´-DDE
GC/ECD	EPA 8081B	4,4´-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	beta-BHC
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene
GC/ECD	EPA 8081B	Chlordane (technical)
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 8260C	2,2-Dichloropropane

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Isopropyltoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl Chloride
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Diethyl Ether
GC/MS	EPA 8260C	Diisopropyl ether
GC/MS	EPA 8260C	Ethanol
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl methacrylate

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Ethyl tert-butyl ether
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Hexachloroethane
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutyl alcohol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	m,p-Xylene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methyl tert-butyl ether
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	tert-Amyl Methyl ether
GC/MS	EPA 8260C	tert-Butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Tetrachloroethene
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	Xylene (Total)

LABORATORY ACCREDITATION BUREAU

Certificate # L2247

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	1,1´-Biphenyl
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	1-Methylnaphthalene
GC/MS	EPA 8270D	2,2´-oxybis (1-Chloropropane)
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	3,3´-Dichlorobenzidine
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	4-Bromophenyl-phenylether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl-phenylether
GC/MS	EPA 8270D	4-Methylphenol

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzyl Alcohol
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270D	Bis(2-chloroethyl)ether
GC/MS	EPA 8270D	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270D	Butylbenzylphthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Di-n-butylphthalate
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethylphthalate
GC/MS	EPA 8270D	Dimethylphthalate
GC/MS	EPA 8270D	Di-n-octylphthalate
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isophorone

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	N-Nitroso-di-n-propylamine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pyrene
UV/VIS	EPA 9031 Mod	Extractable Sulfides
Preparation	**Method**	**Type**
Organic Preparation	EPA 3550B	Sonication
Inorganics Preparation	EPA 3050B	Hotblock
Organic Preparation	EPA 3545	Pressurized Fluid
Organic Preparation	EPA 3540C	Soxhlet
Volatile Organics Prepration	EPA 5035	Closed System Purge and Trap
Inorganics Preparation	EPA 3060A	Alkaline Digestion
Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
Preparation	ASTM D3987	Shake ext of solid waste with water

Notes:

1) This laboratory offers commercial testing service.

State of Connecticut, Department of Public Health

Approved Environmental Laboratory

THIS IS TO CERTIFY THAT THE LABORATORY DESCRIBED BELOW HAS BEEN APPROVED BY THE STATE DEPARTMENT OF PUBLIC HEALTH PURSUANT TO APPLICABLE PROVISIONS OF THE PUBLIC HEALTH CODE AND GENERAL STATUTES OF CONNECTICUT, FOR MAKING THE EXAMINATIONS, DETERMINATIONS OR TESTS SPECIFIED BELOW WHICH HAVE BEEN AUTHORIZED IN WRITING BY THAT DEPARTMENT.

MITKEM LABORATORIES, DIVISION OF SPECTRUM ANALYTICAL, INC

LOCATED AT 175 METRO CENTER BOULEVARD **IN** WARWICK, RHODE ISLAND 02886

AND REGISTERED IN THE NAME OF Hanibal Tayeh, Ph.D.

THIS CERTIFICATE IS ISSUED IN THE NAME OF Yihai Ding - Director, Edward Lawler - Co-Director **WHO HAS BEEN DESIGNATED**

BY THE REGISTERED OWNER/AUTHORIZED AGENT TO BE IN CHARGE OF THE LABORATORY WORK COVERED BY THIS CERTIFICATE OF APPROVAL AS FOLLOWS:

NON-POTABLE WATER/WASTEWATER, SOILS/SOLID WASTE

Examination For:
INORGANIC CHEMICALS
ORGANIC CHEMICALS

SEE COMPUTER PRINT-OUT FOR SPECIFIC TESTS APPROVED

THIS CERTIFICATE EXPIRES December 31, 2011 **AND IS REVOCABLE FOR CAUSE BY THE STATE DEPARTMENT OF PUBLIC HEALTH**

DATED AT HARTFORD, CONNECTICUT, THIS 7th **DAY OF** January, 2009

QUI TRANSTULIT SUSTINET

Registration No.

PH- 0153

SUZANNE BLANCAFLOR, MS
CHIEF, ENVIRONMENTAL HEALTH SECTION

STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL HEALTH SECTION

ENVIRONMENTAL LABORATORY CERTIFICATION PROGRAM

APPROVED ANALYTES REPORT
FOR ALL MATRICES

Mitkem Labs. Div. of Spectrum Analytical

CT-APP-NUM PH-0153

LOCATION

175 METRO CENTER BLVD

Warwick **RI** **02886-**

PHONE **(401)-732-3400**

REGISTERED OWNER/ AUTHORIZED AGENT	**Hanibal C. Tayeh, Ph. D.**
DIRECTOR	**Yihai Ding**
CO DIRECTOR(S)	**Edward Lawler**

APPROVED BY Dermot Jones

DERMOT T. JONES

DATE 01/06/2010 2:44:23 PM

LABORATORY APPROVAL EXPIRATION DATE	12/31/2011
LABORATORY STATUS	**APPROVED**

ANY QUESTIONS CONCERNING THIS DOCUMENT SHOULD BE ADDRESSED TO THE ENVIRONMENTAL LABORATORY CERTIFICATION PROGRAM AT (860) 509-7389

NON-POTABLE WATER/ WASTEWATER

STATUS REPORTED ON 01/06/2010

ANALYTE NAME

PHYSICALS

COLOR
PH
TEMPERATURE
CONDUCTIVITY

MINERALS

ALKALINITY
CHLORIDE
FLUORIDE
HARDNESS, TOTAL
SULFATE
SULFIDE

NUTRIENTS

AMMONIA
KJELDAHL NITROGEN
NITRATE
NITRITE
O-PHOSPHATE
TOTAL PHOSPHOROUS

METALS

ALUMINUM
ANTIMONY
ARSENIC
BARIUM
BERYLLIUM
BORON
CADMIUM
CALCIUM
CHROMIUM
CHROMIUM - Hexavalent
COBALT
COPPER
IRON
LEAD
MAGNESIUM
MANGANESE
MERCURY
MOLYBDENUM
NICKEL
POTASSIUM
SELENIUM
SILVER
SODIUM
THALLIUM
TIN
VANADIUM
ZINC

RESIDUE

TOTAL RESIDUE (SOLIDS)
TOTAL VOLATILE RESIDUE
TOTAL DISSOLVED SOLIDS
TOTAL SUSPENDED SOLIDS

DEMANDS

COD
TOTAL ORGANIC CARBON

MISCELLANEOUS

CYANIDE (TOTAL)
PHENOLICS

INORGANIC DISINFECTION BY-PRODUCTS

BROMIDE

PESTICIDES/ PCB's

POLYCHLORINATED BIPHENYLS
ORGANOCHLORINE PESTICIDES (Single Response)
CHLORDANE (TECHNICAL)
TOXAPHENE

SOLVENTS

OIL AND GREASE
TPH (HEM/SGT)
CT Extractable Petroleum Hydrocarbons (ETPH)

ORGANICS

ACID EXTRACTABLES (PHENOLS)
BENZIDINES
PHTHALATE ESTERS

NITROSAMINES

NITROAROMATICS & ISOPHORONE

POLYNUCLEAR AROMATIC HYDROCARBONS

HALOETHERS

CHLORINATED HYDROCARBONS

VOLATILE ORGANICS

SOLID WASTE/SOIL

STATUS REPORTED ON 01/06/2010

ANALYTE NAME

PHYSICALS

PH

METALS

ALUMINUM

ANTIMONY

ARSENIC

BARIUM

BERYLLIUM

CADMIUM

CALCIUM

CHROMIUM

CHROMIUM - Hexavalent

COBALT

COPPER

IRON

LEAD

MAGNESIUM

MANGANESE

MERCURY

MOLYBDENUM

NICKEL

POTASSIUM

SELENIUM

SILVER

SODIUM

THALLIUM

VANADIUM

ZINC

MISCELLANEOUS

CYANIDE (TOTAL)

IGNITABILITY

CORROSIVITY

TCLP LEACH (1311)

SPLP LEACH (1312)

PESTICIDES/ PCB's

POLYCHLORINATED BIPHENYLS

ORGANOCHLORINE PESTICIDES (Single Response)

CHLORDANE (TECHNICAL)

TOXAPHENE

SOLVENTS

CT Extractable Petroleum Hydrocarbons (ETPH)

TRIAZINE PESTICIDES

ATRAZINE

RCRA (SW-846) ORGANICS

VOLATILE ORGANICS (SW 8260)

ACID EXTRACTABLES (PHENOLS) (SW 8270)

3,3'-DICHLOROBENZIDINE (SW 8270)

PHTHALATES (SW 8270)

NITROSOAMINES (SW 8270)

NITROAROMATICS & CYCLIC KETONES (SW 8270)

PAH's (SW 8270)

HALOETHERS (SW 8270)

CHLORINATED HYDROCARBONS (SW 8270)

REPORT PROFILE

Report Printed on: 01/06/2010 2:44:23 PM
Report Name: APPROVED TESTS_ALT_NEW
Printed by: dermot
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lab code = ID1219P
test code = *
matrix code = *
matrix selection = ALL OR SOME MATRICES SELECTED
certifications approved or provisional on 01/06/2010

THIS IS THE LAST PAGE OF THE REPORT